WATER WORKS AND SEWERAGE

May, 1935 — Editor — Vol. LXXXII. No. 5

The Sewage Treatment Works of Geneva, Ill. A Study in Plant Beautification (Wells Engineering Co., Engineers)

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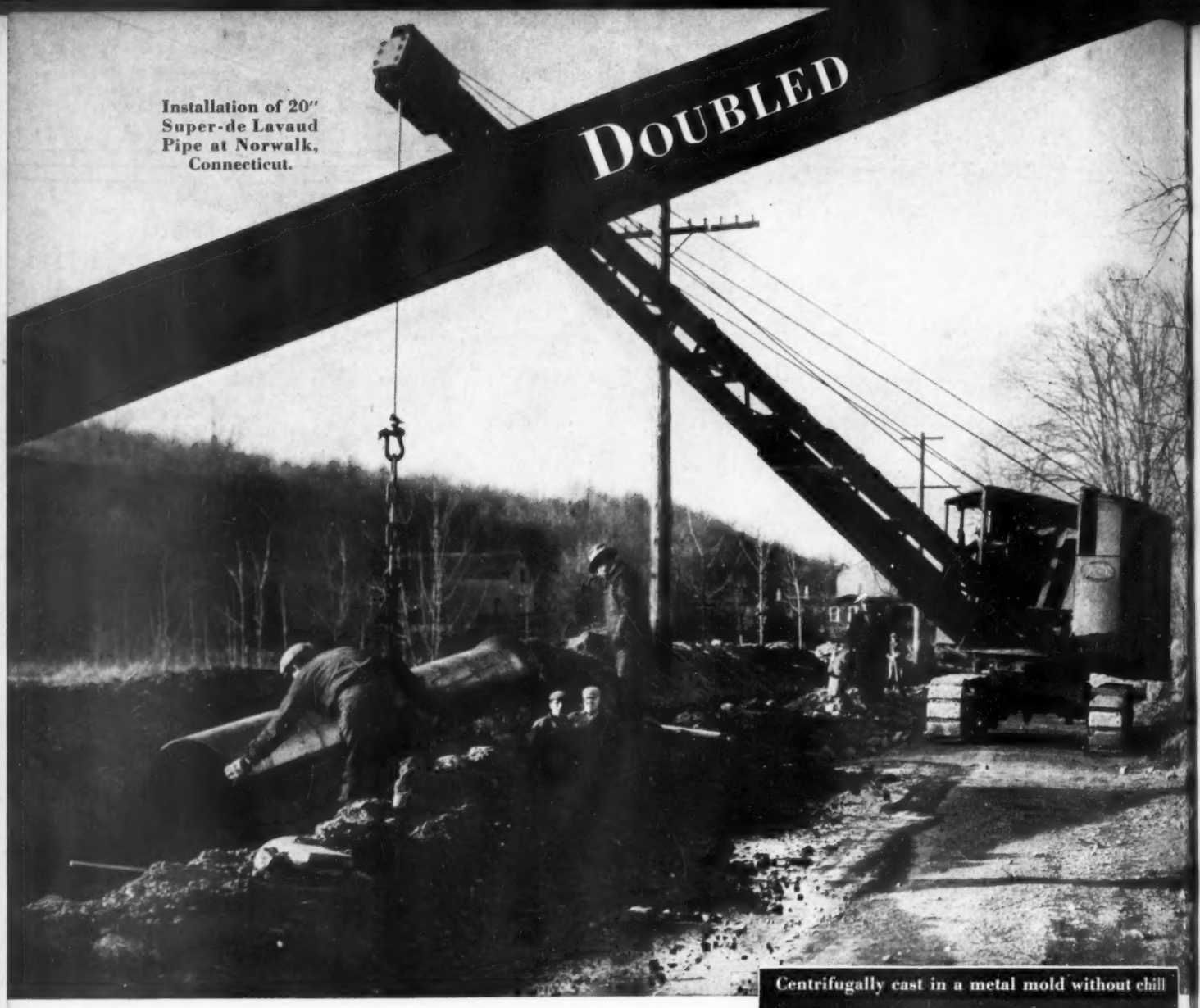
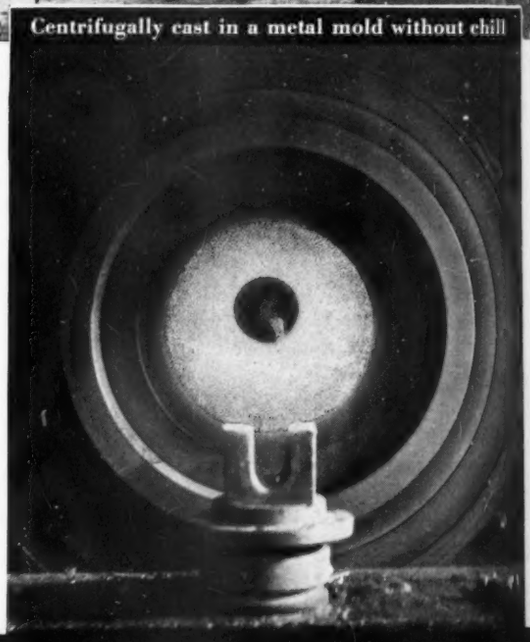
Effect of Chlorine on Activated Sludge
The Geneva Sewage Treatment Works
Filtered Water Served at Well-Water Temperature
Money Saving Methods in Purification Plant Operation
Report of Annual Convention of American Water Works Association
Chlorinated Iron Solves Odor Nuisance and Improves Digester Performance



Installation of 20" Super-de Lavaud Pipe at Norwalk, Connecticut.

DOUBLED STRENGTH to resist impact shocks means that Super-de Lavaud Pipe offers these plus-values: super-service underground—and maximum protection from plant to underground. Two years ago that statement was based on exhaustive tests. Today it is confirmed by the experience of purchasers who have installed nearly *eight million feet.* Super-de Lavaud Pipe is the result of a patented process amounting to a basic discovery whereby gray iron is *centrifugally cast against metal without chill.* Ductility and toughness are increased, and impact resistance *more than doubled,* without reduction of tensile and bursting strength. We shall be glad to send you a booklet describing the Super-de Lavaud Process.



Centrifugally cast in a metal mold without chill

U.S. SUPER-de LAVAUD PIPE

CAST WITHOUT CHILL IN A METAL MOLD

UNITED STATES PIPE AND FOUNDRY CO., General Office: BURLINGTON, N. J.

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WATER WORKS & SEWERAGE

L. H. ENSLOW,
Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues

Paul Hansen, Consulting Engineer, Chicago and A. R. Garnock, City Engineer, Eau Claire, Wisc., relate interesting experiences and methods employed in locating and proving a ground water supply free from iron and manganese for Eau Claire, Wisc. Also, the plan followed in beautifications of pump stations and reservoir is described.

E. F. Eldridge, Research Engineer, Michigan Experimental Station, East Lansing, Mich., will report on what chemical precipitation studies disclosed in respect to effectiveness of purification and chemical dosages required to attain increasing B.O.D. reductions (to 90 per cent) of meat packing house wastes. Coagulation by super-chlorination plus a minor dosage of ferric iron, for weighting of precipitate, proved the most effective and economical combination of chemicals.

"Thirteen Years of Operation of the Tucson (Ariz.) Water Department" as reviewed by L. R. Burch reveals an outstanding record—financially and otherwise. It reveals what a live waterworks organization has been able to accomplish in the Arizona desert under trying conditions, both natural and financial.

"Filtration Developments in the Sewerage Field" as reviewed by P. B. Streander, Cons. Engr., New York City, is an illustrated description and analysis of the several schemes which have been developed to remove suspended solids from sewage treatment plant effluents by filtering or straining devices.

Wm. M. Rapp, Supt. Distribution, Atlanta, Ga., Water Department in this issue describes an ingenious (natural) water cooling scheme for outside or inside fountains. In a future issue he will reveal data gathered on the variations in consumption demands by apartment houses and other large buildings—information of considerable value in planning service lines and meter installations.

Mark B. Owen, Supt. Public Works, Dearborn, Mich., will describe the new Herreshoff type of incinerator installed to burn chemical sludge from the Dearborn plant. Operating results, installation and operation costs will be revealed.

A. M. Rawn, Assistant Chief Engineer, Los Angeles, Los Angeles County Sanitation Districts, will tell of several "Kinks" employed to improve operation and maintenance of sewers and sewage treatment works of the Los Angeles County system.

R. B. Simms, Supt. Water Works and Sewerage, Spartanburg, S. C., will tell of betterments to the Spartanburg distribution system making possible the carrying of heavier peak loads and the expedient of encouraging lawn sprinkling at special reduced summer rates. The elevated tank (P.W.A.) project adds flexibility to consumer service, makes for satisfied customers. Greater beautification of the city and other intangible benefits, if not actual cash register profits to the Water Department, is the result.

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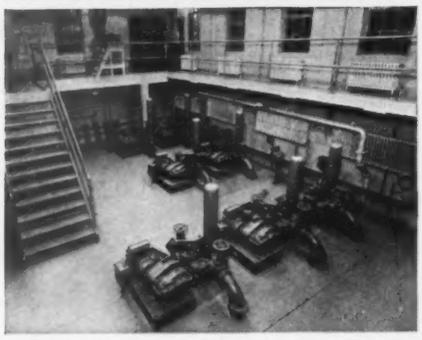
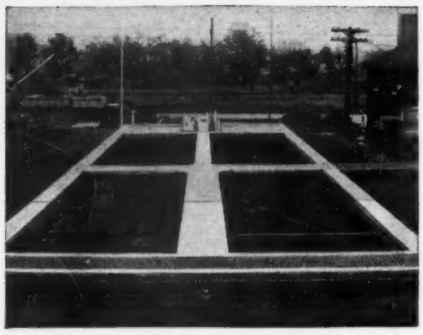
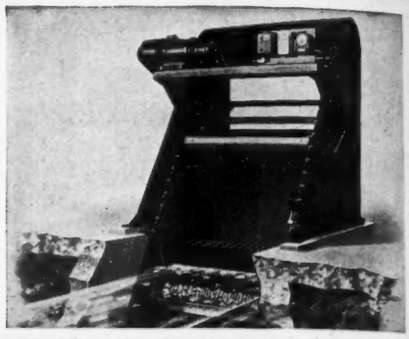
EACH PHASE OF SERVICE







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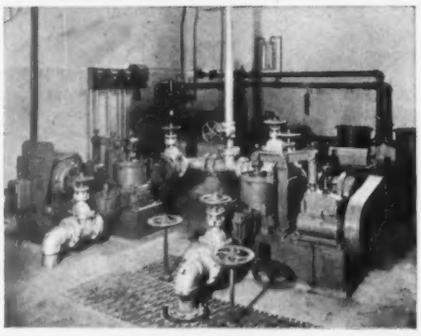
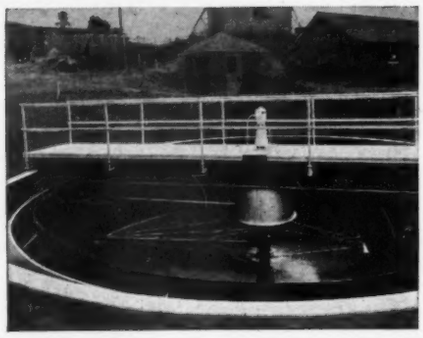
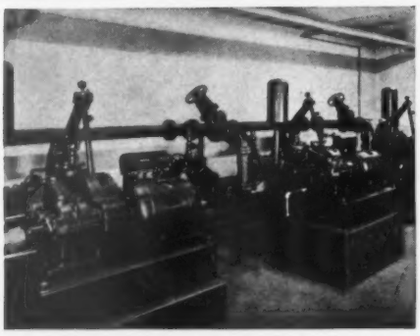
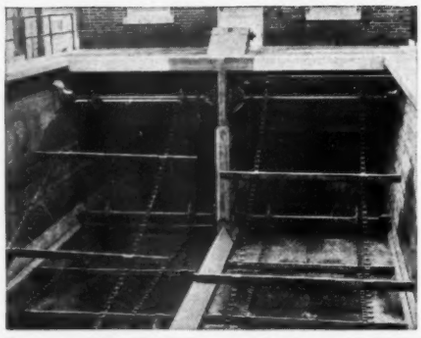
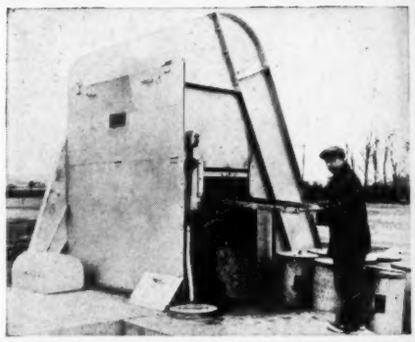




In Sewage Disposal and Water Treatment Plants







Is Handled by These Veterans of the Rex Sanitation Corps

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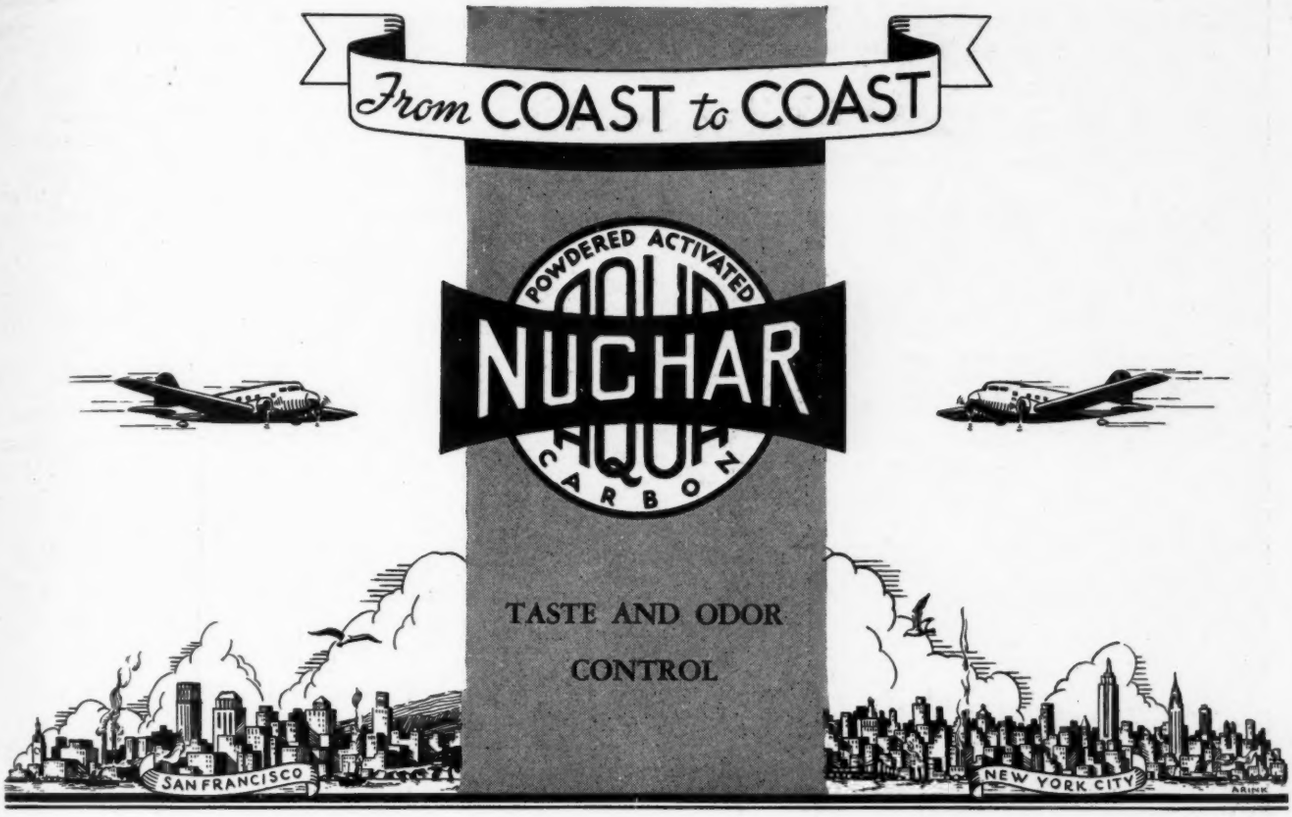

SINCE the period in which Activated Carbon (AQUA NUCHAR) was introduced for taste and odor removal, it has reached the place where it may be truly said to be in demand from coast to coast.

In this period in excess of 700 plants have used AQUA NUCHAR—some only during the peroid of severe taste and odor problems—others continuously, to insure taste and odor control (resulting in the furnishing of palatable water and thus creating good will with the consumers).

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Yes—we would like you to mention WATER WORKS AND SEWERAGE.

What Mr. Foutz of the La Porte Water Works says about HTH ...

View of La Porte Water Works showing filter house at left, pump house at right and aerating basin at extreme right. C. C. Foutz, superintendent, recommends HTH "to all those responsible for the safeguarding of water supplies."

"WE believe HTH to be the best thing of its kind for the treatment of water systems," says C. C. Foutz, prominent in water works circles and superintendent of the La Porte Water Works, La Porte, Indiana.

"We first used HTH here about six years ago. At that time this plant was re-built and filtering beds installed. Following this construction work the B coli count was dangerous and after some investigation as to what we could do to correct it we purchased our first supply of the product and sterilized the entire plant including aeration, settling and clear water basins, pumps and filters. The situation was immediately cleared up and we experienced no further trouble.

"Following this we used HTH to clear up occasional contamination in our wells until the installation of our present chlorination plant four years ago. We also use it in the periodical cleaning of our basins and filters; in the installation of all new mains; and for sterilizing after any construction work around the plant.

"On several occasions we have had occasion to recommend its use to rural schools and to private parties whose water supplies showed contamination. In each case the use of HTH has cleared the situation up without difficulty.

"We feel, therefore, that we are qualified from wide experience to recommend its use to all those responsible for the safeguarding of water supplies."

The MATHIESON ALKALI WORKS (Inc.)
60 East 42nd Street New York, N. Y.

Soda Ash... Liquid Chlorine... Bicarbonate of Soda... HTH and HTH-15... Caustic Soda... Bleaching Powder... Ammonia, Anhydrous and Aqua... PH-Plus (Fused Alkali)... Solid Carbon Dioxide.

Eliminate the spark hazard with tools of *NON-SPARKING* BERYLLIUM COPPER

A few representative items in the complete line of non-sparking tools made by STANLEY TOOLS, New Britain, Conn., from wrought Anaconda Beryllium Copper.

GREAT strength, fatigue limit and hardness, plus the fact that it is non-sparking, makes Beryllium Copper ideal for tools used in treatment works and at manholes... where the presence of sludge or sewer gases may create an explosion hazard.

To meet the safety requirements of municipalities and other interests responsible for workmen and property in inflammable surroundings, chisels, hammers, sledges, wrenches, scrapers, etc., made of wrought Anaconda Beryllium Copper are now available.

* * *

From the fabricating standpoint, Beryllium Copper in the annealed state may be worked either hot or cold, and is readily rolled, drawn, stamped and forged. Subsequent heat treating of finished parts increases tensile strength, fatigue limit and hardness to a point beyond that obtainable in any other non-sparking material.

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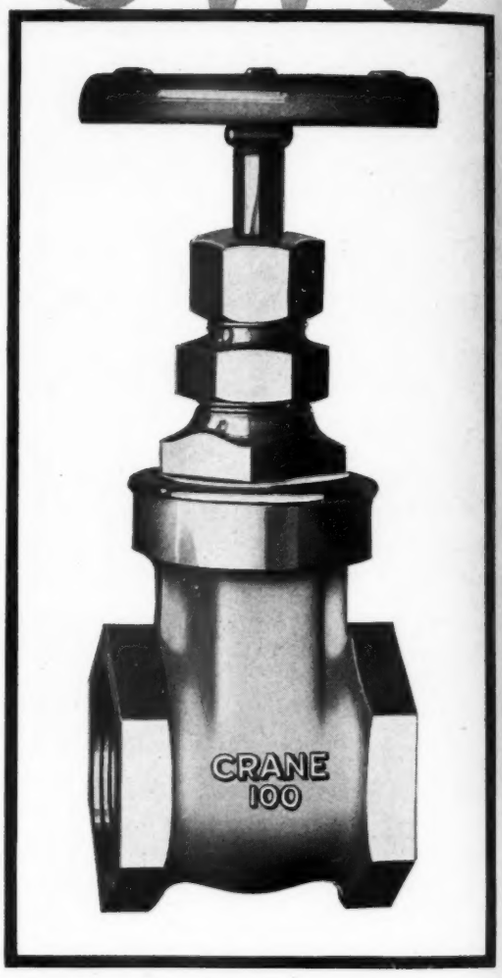
Invite neglect

THERE'S no one on guard in the dark corners where valves and fittings in water lines must do their tasks. That's where the design and material in a valve show their worth. Fair target for corrosion and strains, the valve that holds tight, opens easily, and closes tight again is the valve that pays you back the money it cost. Such are Crane Valves, designed and manufactured to endure—at top efficiency—for years.

The Crane Gate Valve pictured here is one of them. Used on both sides of the meter in water service lines, its rugged bronze construction gives years of satisfactory service—and at no premium in price. It is a valve of low first cost. And every year it serves reduces that cost far below the value of the service it renders.



CRANE 449½ BRONZE GATE VALVE

Non-rising stem. For working pressures up to 100 lbs. Screwed bonnet. Solid wedge disc with gland in stuffing box. Uniformly machined. Sizes ½" to 2".

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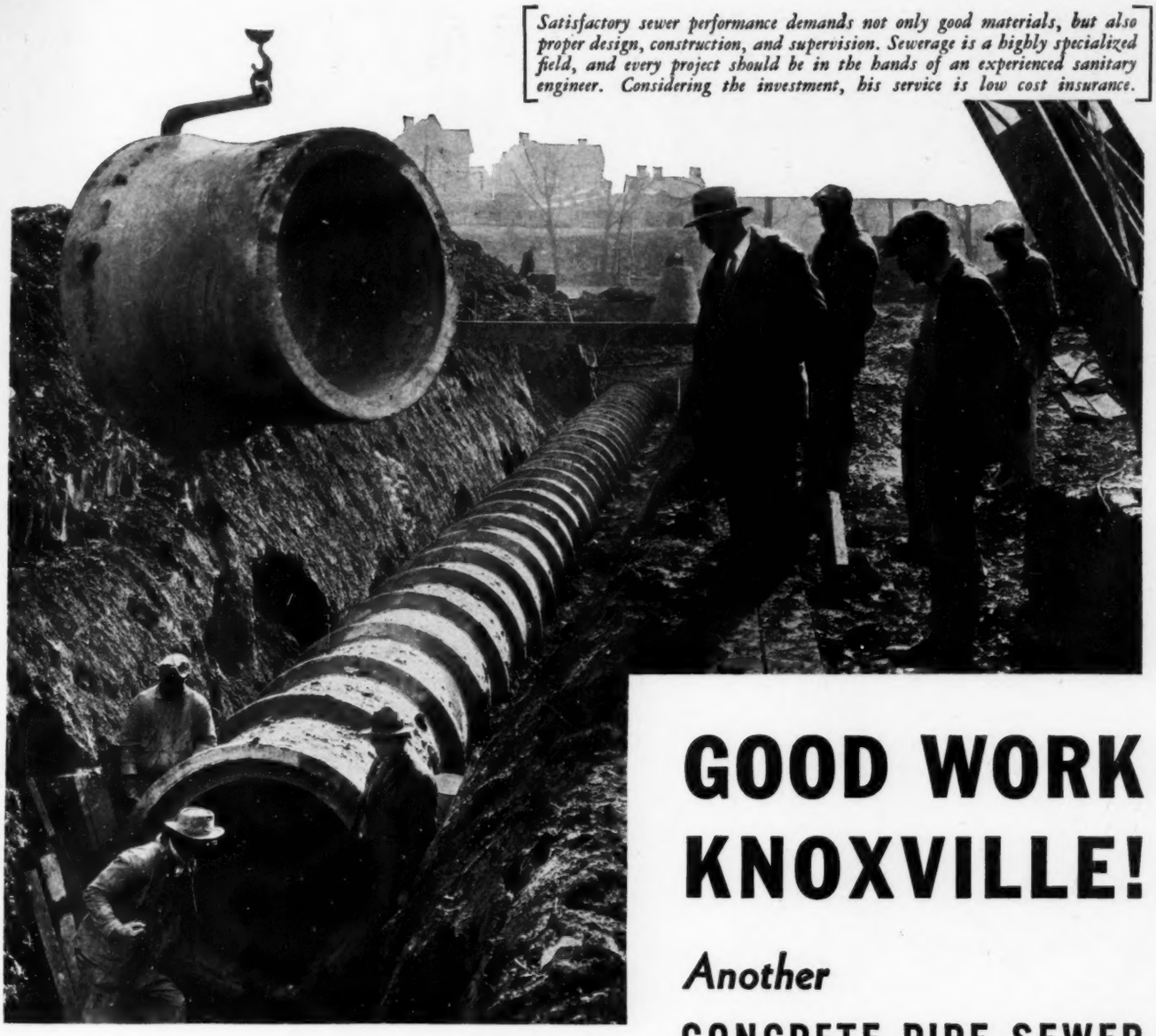
Satisfactory sewer performance demands not only good materials, but also proper design, construction, and supervision. Sewerage is a highly specialized field, and every project should be in the hands of an experienced sanitary engineer. Considering the investment, his service is low cost insurance.



GOOD WORK KNOXVILLE!

Another CONCRETE PIPE SEWER WITH *Watertight Joints—and Gradient O. K. Within .01 Ft.*

THE Broadway intercepting sewer, shown, consisting of 20,100 feet of 30-48 inch reinforced concrete pipe, was constructed at Knoxville, Tenn., in 1930-1931, at a cost of $338,602.93.

The sewer was built on grades to provide velocities from 3.6 to 8 feet per second. 1500 feet of this sewer was built (with concrete pipe) in tunnel. Joints were carefully made with portland cement mortar to minimize leakage or infiltration. The sewer was built adjacent to a stream, partly through rock and partly through very unstable foundation conditions. 1000 piles were used to provide adequate foundation where required. The cut to invert varied from 6 to 29 feet and the pipe line was carefully bedded and backfilled. Only 150 feet (16-ft. cut to invert) was bedded in foundation concrete.

The city engineers of Knoxville said on March 6, 1935, that final inspection revealed that all joints were watertight. Moreover, the gradient of the sewer, as finally constructed, checked to within .01 foot of the established gradient at numerous points.

Knoxville today has more than 200 miles of concrete pipe from 6 to 48 inches in diameter in its sanitary sewerage system.

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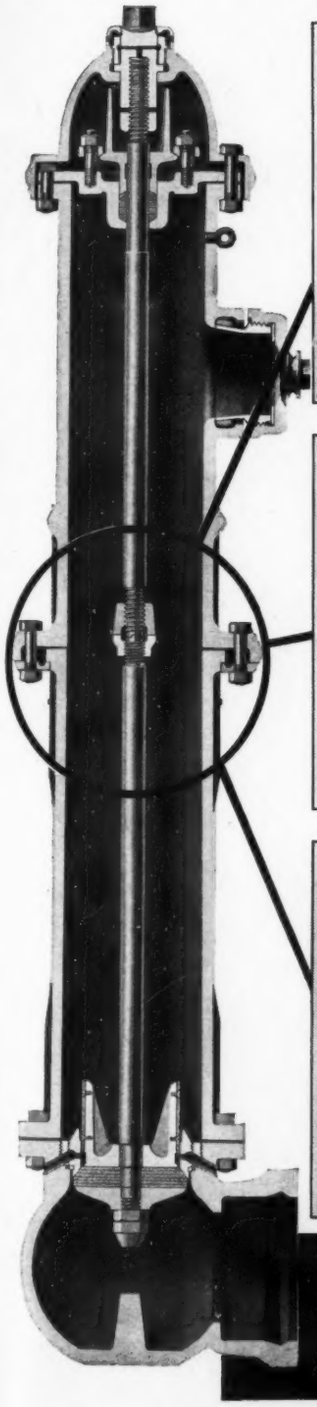
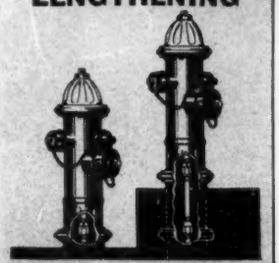
We call it a "Safety Flange"

--but "safety" is only part of the story--



LENGTHENING

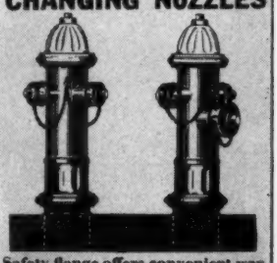


Simply remove safety flange and coupling and add section as shown. Then install solid flange and coupling at lower end of section and safety flange and coupling at upper end. No water cut-off; no digging.

SWIVELING

Simply loosen the eight bolts that hold the safety flange in place and swivel hydrant to any degree of a circle. No digging. No water cut-off.

CHANGING NOZZLES



Safety flange offers convenient way of removing barrel section having only hose nozzles, and replacing it with section having both hose and steamer nozzles. No water cut-off. No digging.

OF course the primary purpose of the safety flange of the Columbian Fire Hydrant is to confine breakage by trucks or automobiles to a few inexpensive parts. But do not overlook the fact that it also offers three other important advantages:

(1) An inexpensive way of lengthening the hydrant to conform to new grade levels.

(2) A simple means of swiveling the barrel so that the nozzles can be faced to any degree of a circle.

(3) A simple, quick way of adding steamer connections to hydrants as conditions call for steamer nozzles.

All of these changes are made, as illustrated, without digging, without cutting off water, and at minimum cost. Cities grow, grade levels change; conditions change. Therefore even if the greater feature of protecting vital parts were forgotten, these three features of lengthening, swiveling and changing connections would make Columbians a sound investment.

In addition to these features the Columbian offers the unduplicated self oiling feature, positive protection against freezing, easy main valve removal, cut-resistant, double-life main valve, and many other features that are found in no other hydrant.

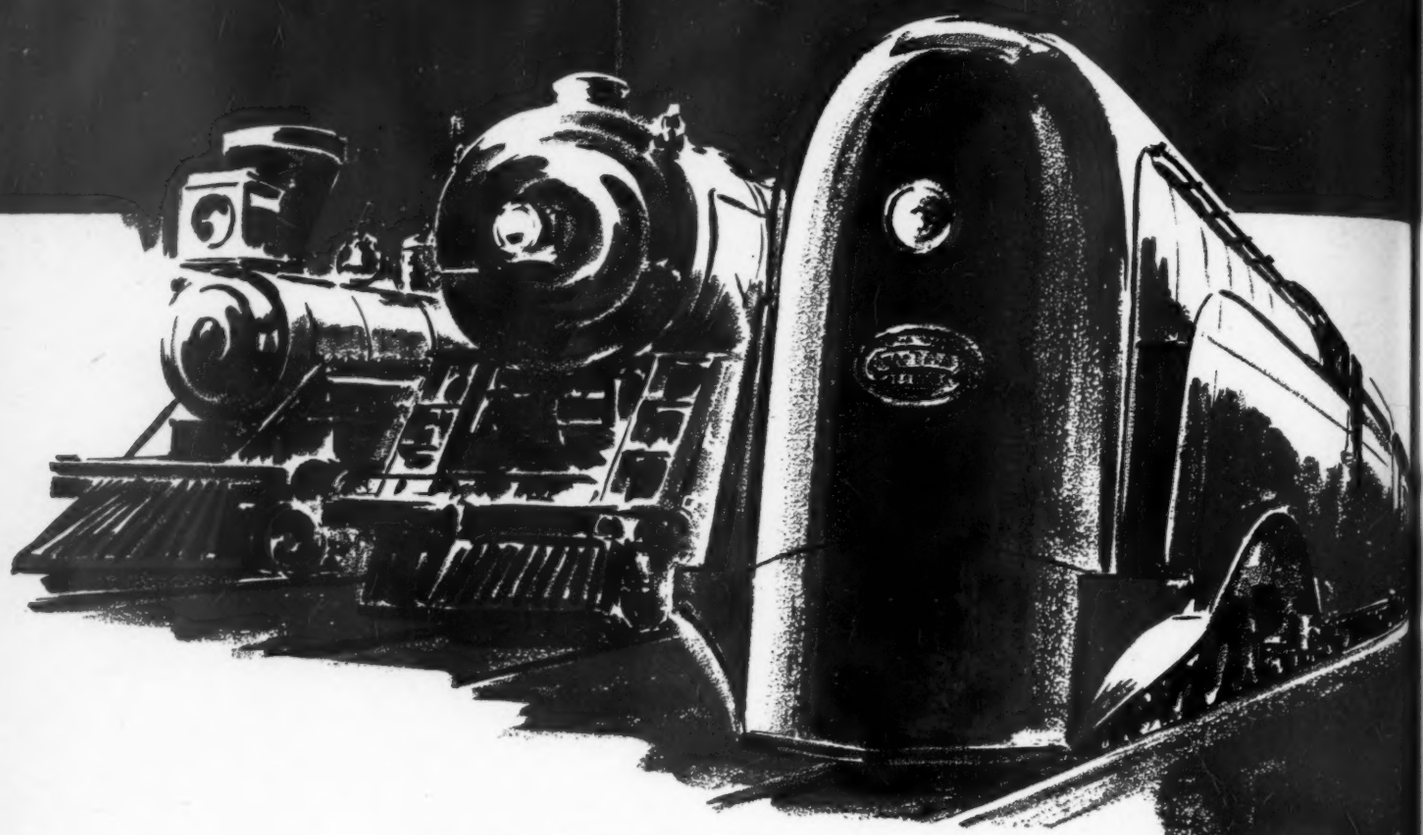
Write today for detailed description of your *future* fire hydrant.

COLUMBIAN IRON WORKS
Chattanooga, Tennessee
Division of MUELLER CO.
Decatur, Illinois

COLUMBIAN

FIRE HYDRANTS AND GATE VALVES

Has your water treatment *kept pace* with locomotive development?



Boiler water supplies were never more important than they are today. Modern locomotives . . . powerful and highly efficient . . . require boilers that will stand up under heavy steam demands and that can be kept in continuous service for extended periods.

Nalco Water Treatment has kept pace with locomotive development. Better treating materials have been introduced . . . automatic and inexpensive treating equipment has been designed . . . methods have been simplified.

In addition to modern materials and equipment, the Nalco System includes the vital feature of an expert service organization with a careful system of supervision, checking and co-ordination.

Modernize your water treatment

NATIONAL ALUMINATE CORPORATION
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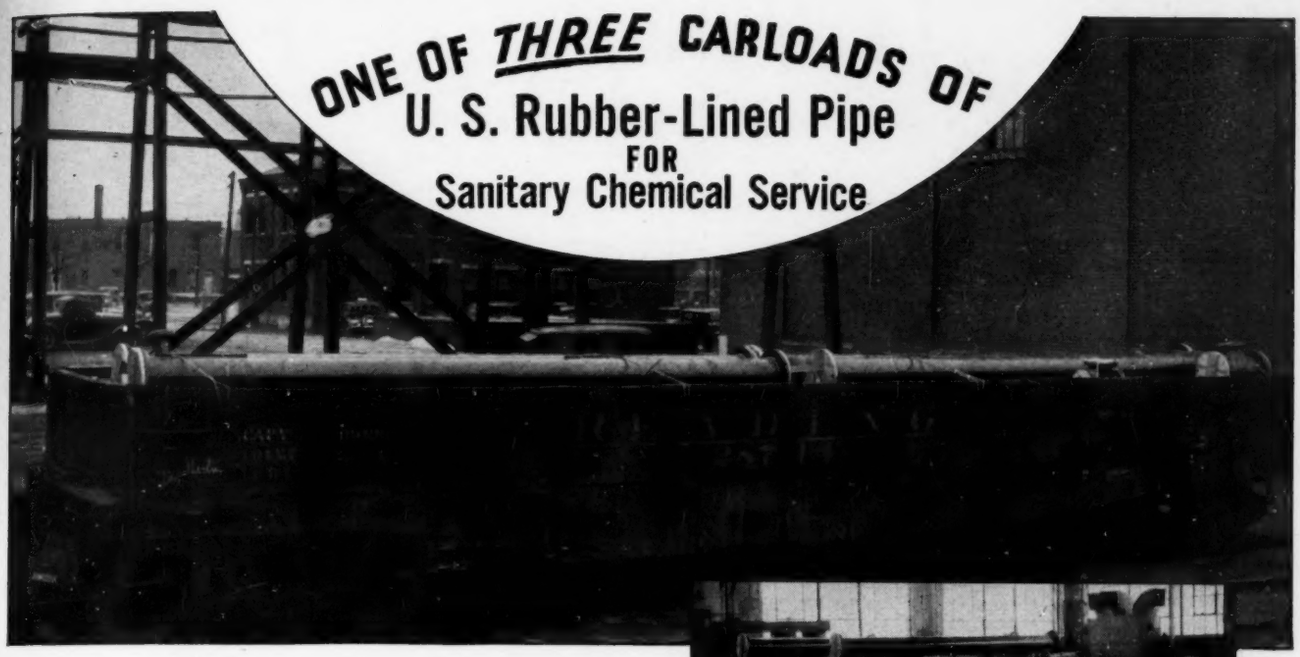
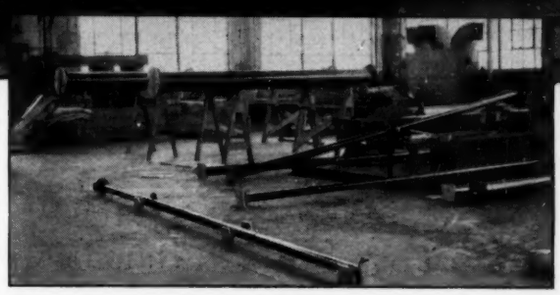
NALCO SYSTEM
OF WATER TREATMENT





● "U.S." Permobond rubber-lined pipe, fittings, and tanks for handling solutions of chlorine and ferric chloride have proved an outstanding success in water works and sewage disposal plants.

"U.S." has made available a broad selection of practical equipment, developed through years of experience in the anti-corrosion field. Consequently, sanitary engineers and sewage plant operators have been able to make ready use of "U.S." Permobond flanged pipe and rubber-lined accessory fittings such as ells, tees, crosses, reducers and valves.

Flanged pipe may be had in sizes from 1½ inches to 36 inches in diameter, and can be lined in lengths up to and including 20 feet. All types of fittings can also be furnished.

The "U.S." technical staff is always at your service for information and advice on anti-corrosion equipment. Inquiry involves no obligation whatever. Address the nearest branch of United States Rubber Products, Inc.

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By
EDWARD S. HOPKINS
Principal Sanitary Chemist, Bureau of Water Supply, Baltimore, Md.

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—Excerpts from the Foreword

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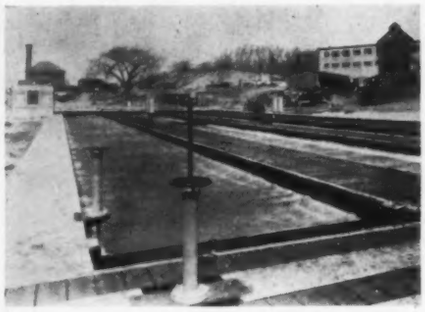

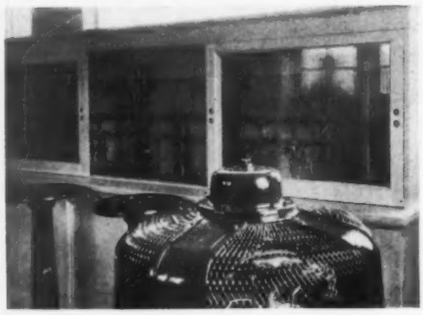

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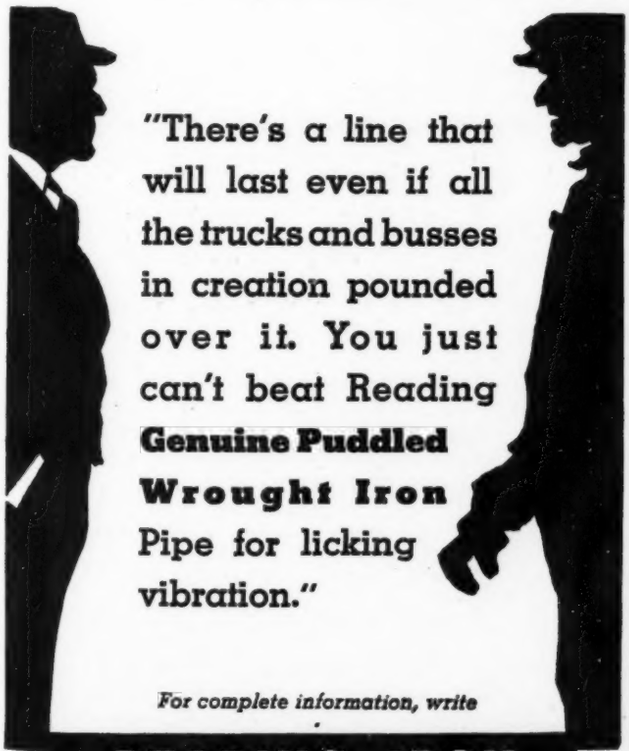

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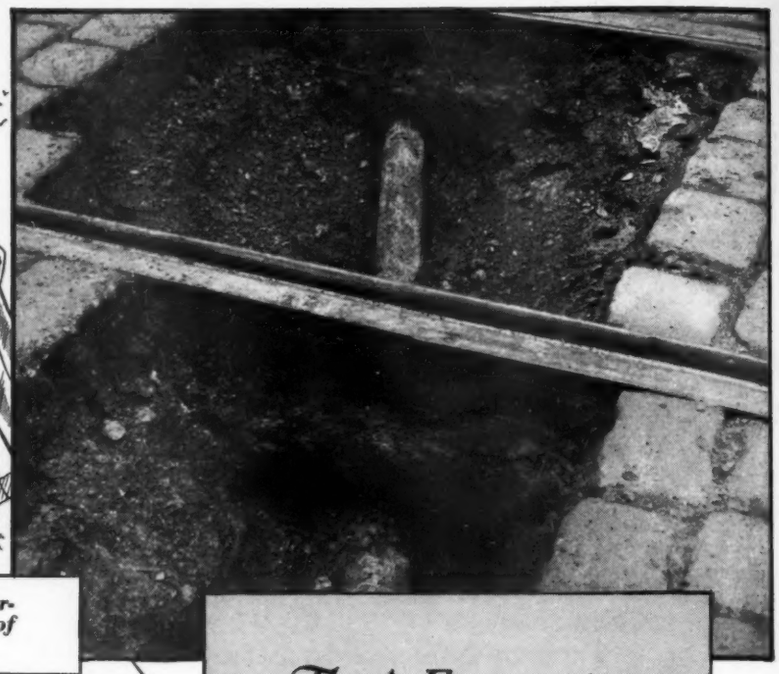
1726 this pipe was laid -still in service 1935

This pipe was laid in Germany during the reign of Frederick the Great



THE cast iron water main shown above has served the German city of Ehrenbreitstein for more than two centuries. Over his official seal, the Burgomeister recently wrote, "The water main . . . was replaced in 1726 by cast iron pipes...crosses the much-frequented tramway . . . and lies partly under the provincial street to Arenberg with its heavy traffic. On the occasion of an excavation the enclosed photographs have been made . . . these show the position and the good condition of the pipes." Note that this pipe has bell-and-spigot joints. It is but one of many installations which demonstrate that the useful life of cast iron pipe is more than a century.

The four major economies resulting from the long life of cast iron pipe are due to its effective resistance to rust. Cast iron is the one ferrous metal for water and gas mains, and for sewer construction, that will not disintegrate from rust. This characteristic makes cast iron pipe the most practicable for underground mains since rust will not destroy it.

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2. Official reports on file in the office of a prominent technical publication, prove that cast iron pipe is *cheapest to maintain.*
3. Long-lived pipe obviously causes less street-opening for replacements and repairs. Therefore, cast iron pipe *saves money on street openings.*
4. When replaced by larger pipe, or a main is abandoned or rerouted, cast iron pipe *pays a final dividend in salvage value.*

For further information, address The Cast Iron Pipe Research Association. Thomas F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago, Ill.

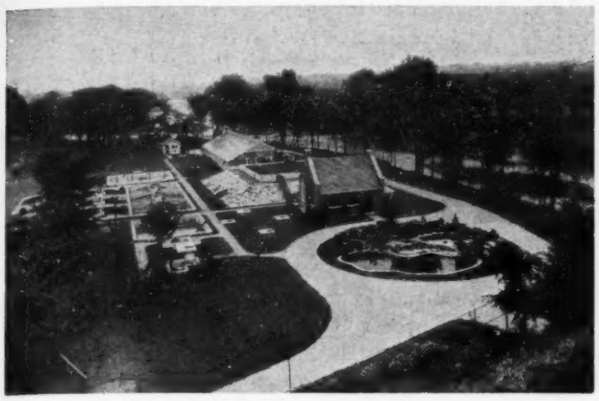
Photo by courtesy Deutscher Gussrohr-Verband G. m. b. H., Cologne

CAST IRON PIPE

METHODS OF EVALUATING BIDS NOW IN USE BY ENGINEERS — RATE THE USEFUL LIFE OF CAST IRON PIPE AT 100 YEARS

TRADEMARK REG.

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. LXXXII MAY, 1935 NO. 5



The Sewage Treatment Works of Geneva, Ill. A Study in Plant Beautification

THE GENEVA SEWAGE TREATMENT WORKS

A Plant Built With Park Surroundings

By E. ROY WELLS, C. E.*
Geneva, Ill.

"TO DESIGN a plant for the treatment of sanitary wastes that was both efficient, fitting to the surroundings and pleasing in appearance." These were the instructions given the writer in 1931 by the Council of the City of Geneva, Illinois.

Geneva is a residential city with a population of 5,000 inhabitants located in the beautiful Fox River valley about forty miles west of Chicago. The Fox River which divides the city into two sections is considered by Illinois sanitary officials to be one of the most valuable rivers in the state. Legislation has consequently been enacted to eliminate the pollution of the stream and thereby restore it to its original beauty so that it can be used for fishing and other recreational purposes.

The extent to which the territory in and adjoining Geneva is populated made the selection of ground adaptable for a plant site a difficult one and it became essential to select a type of treatment which would not create a nuisance because of odors. The plant had to be one which would require a minimum amount of ground area. The site selected was a small peninsula of about three acres located on the easterly side of the Fox River and the type of treatment selected was the activated sludge process.

The plant was designed for a population of 8,500 persons based on a design load of 100 gallons per capita per day. It is anticipated that the plant will be of sufficient size without additional units until 1950. However, the plant was so laid out that additional units may be added when necessary.

The Plant

Comprising the plant, here pictured, is a screen chamber with manually cleaned coarse bar screen, meter chamber with Venturi tube, hopper bottom primary sedimentation tank, nine aeration tanks equipped with motor driven mechanical aerators, two final clarification tanks equipped with motor driven sludge removal equipment of the straight line type, digester equipped with floating cover and hot water heating coils, sludge drying bed with glass enclosures, and a service station housing the pumping equipment, gas boiler, flame trap, motor control switchboard, lockers and other appurtenances in the basement. The laboratory, sewage meter and office are on the main floor.

Although the sewer system of the city is strictly a sanitary system, the flows are greatly increased during storm periods by infiltration and roof water that is being discharged into the sewers. Consequently, the outlet end of the meter chamber and outlet end of the primary tank is each provided with stop-boards and valves so that flows in excess of 500 gallons per capita per day may be by-passed to the stream ahead of the primary tank and flows in excess of 200 gallons per capita per day may be by-passed to the stream after receiving primary (settling) treatment.

The primary tank is designed for a detention period of 1½ hours at average design flow. The sludge is removed to the digester by a 100 G. P. M. motor driven vertical non-clogging centrifugal pump.

The aeration tanks are equipped with stop-boards so that any number of tanks in different combinations in excess of four may be used. The tanks are designed to provide a 7½ hour period of aeration at maximum load, with 25 per cent return sludge.

The final tanks provide a two hour detention at design

Rock Garden and Lily Pool at the Park Entrance Appeals to Visitors

*President, Wells Engineering Company.

Nine Mechanical Type Aeration Units Are Interconnected to Provide Maximum Flexibility in Operation

flow and the outlet weirs are constructed in the H type to provide 102 feet of effective length of weir for each tank.

The digester has a capacity of 2.5 cubic feet per capita. It is surrounded by an earth embankment to reduce heat losses and the sides of the embankment are covered with thin slabs of limestone of random sizes laid flat. Vines and low shrubs have been planted between the slabs to enhance the appearance of the plant.

The glass enclosed sludge bed has a capacity of one square foot per capita based on present population. The bed is divided into four parts by slate slab planks which have proven very effectual. The dried sludge cake is loaded into a bucket carrier operating on a monorail system and conveyed to the rear of the bed for disposal.

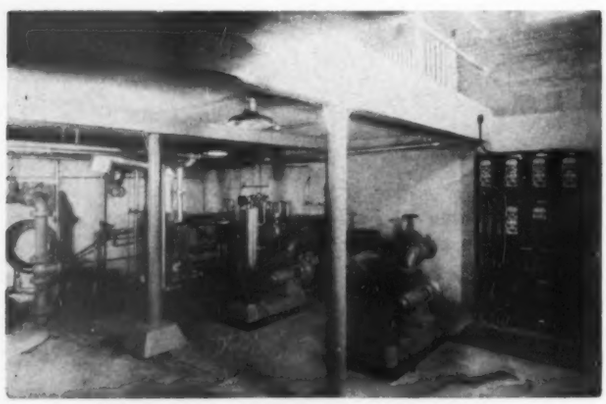
The switchboard in the service station provides complete metering facilities for separating current used for lighting and the different power units. An accurate record can be kept of the energy consumption of each unit of electrical equipment in the plant.

Laboratory facilities have been provided so that routine tests are made to insure the proper operation of the plant. The plant was placed in operation on October 1, 1933.

Operating Results

A resume of the plant's operation for the year 1934 shows the following:

Average daily sewage flow	509,000 gals.
Average dry solids to digester per day	1073 lbs.
Average gas yield per day	7022 cu. ft.
Average digester pH	7.1
Average digester temperature	76 deg. F.
Total power per million gals. treated	460 kw. hr.
Total sludge drawn to beds	180 cu. yds.
Total dry sludge removed from beds	35 cu. yds.
Suspended solids, average reduction	96.9 per cent
Total volatile solids, average reduction	51.0 per cent
Oxygen consumed, average reduction	82.2 per cent
5 day B.O.D. average reduction	97.0 per cent



Basement of Service Station. Note the Six Individual Meters on the Switchboard

The plant is manned by two operators, each employed so that at least one is on duty during the daylight hours and both are subject to call at night if necessary. In addition to properly operating the plant, in which cleanliness is paramount, the operators have charge of the grounds. The attractive rock garden and lily pool here illustrated is an example of what can be done at moderate expense to make a plant attractive. This was built under supervision of the operators by relief labor that was furnished them. In addition, the entire plant grounds has been landscaped with shrubs and flower beds.

Both the plant, its location and performance fulfill the requirements as laid down by the Council when the project was first proposed. And, Geneva's citizenry is proud of its efficient sewage treatment plant operating in the municipal "Sewage Works Park."

▼

Electrochemical Society Medalist President of Carborundum Co.

Frank J. Tone, president of The Carborundum Company of Niagara Falls, N. Y., has been awarded the Edward Goodrich Acheson Medal which is the highest honor bestowed by The Electrochemical Society. This is the second distinguished award to come to Mr. Tone in recent years, he having been the first recipient of the Jacob F. Schoelkopf Medal of The American Chemical Society.

Frank J. Tone

The Acheson Award goes to Mr. Tone for his pioneering work with electric furnaces and many important contributions to the development and perfection of practical and commercial processes in the field of electrochemistry and electrometallurgy, these contributions extending their benefits to the field of all useful arts. Especially important was his work in abrasives and refractory materials out of which developed "Aloxite" and in air-diffusors and filtering plates.

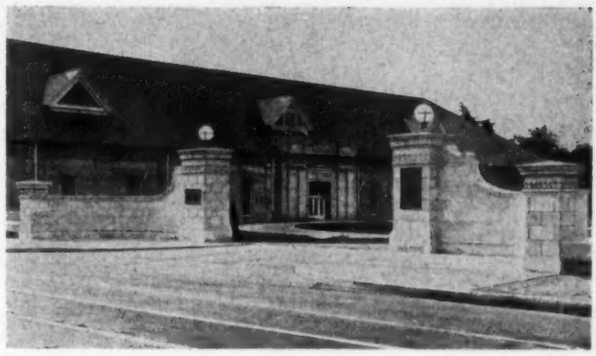
Mr. Tone has had one hundred and forty-five patents granted to him over a period of 33 years and a number of others are still pending.

▼

A Correction

In the "Presentation of Representative Water Works Plants" which picturized numerous filtration plants in our April issue, the design of the Meander Creek dam and plant of the Mahoning Valley Sanitary District (p. 148) was erroneously credited to G. Gale Dixon of Youngstown, O.

W. H. Dittoe is Chief Engineer of the Mahoning Valley Sanitary District and was responsible for the project on which Mr. Dixon served as Principal Assistant Engineer. We are pleased to correct this mistake which was called to our attention by Mr. Dixon, through whom the photographs were secured.



Hermany Gateway: Memorial to Chas. F. Hermany at Louisville, Ky., Plant.

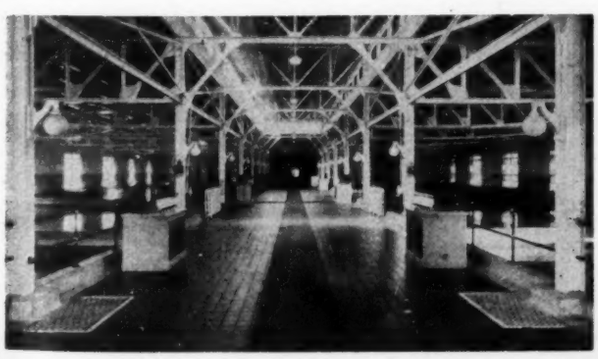
MONEY SAVING METHODS IN PURIFICATION PLANT OPERATION

By W. H. LOVEJOY
Supt. of Filtration,
Louisville, Ky.

FOR THE past several years there has been a growing tendency toward increasing costs of operation in nearly all water purification plants. Of course, we need not go far to find the several reasons behind this tendency. Raw water problems are increasing in number and complexity each year as a result, principally, of recurrent drouth periods and increasingly heavier loads of sewage and industrial wastes in the river supplies. On the other hand we are confronted with the consumer who is now educated to expect and, in fact, demand each year higher standards of water quality. On top of all this, the prices of chemicals and all other purification plant materials have gradually increased during this same period.

It is a fact, also, that progress in purification methods and technique has kept pretty well apace with our problems during this period. Thus, we plant operators have the tools to work with in solving most of our problems. The only fly in the ointment is usually that of getting our company's* consent and financial backing to adopt each of these new refinements in treatment and keeping everyone satisfied in the face of a constantly increasing budget each year.

At the Louisville plant we have seen this coming for a long time and have been busy trying to offset the rising operation costs by means of economics wherever possible. What we have tried at all times to do is to give the consumer the benefit of every possible improvement in treatment, but at the same time, do it as economically as possible. We have, at least, made a great effort to "cut corners" and introduce economies not only in operation work but also in construction and maintenance jobs as well. Some of the more important plant savings during the past fifteen years are recorded here.



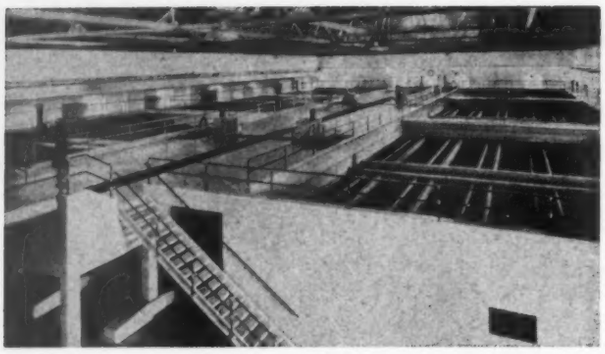
Operating Floor of East Filters, Louisville, Ky.

Savings Made on Reconstruction Jobs

In 1924 it was decided to revamp a battery of twelve 3.0 mgd. filter units that had been built in 1914. These units had been so poorly designed and equipped that they had been used only in emergencies, and then with difficulty, for ten years. After much discussion this work was delegated to our own plant forces rather than to a contractor. This work consisted of tearing out the operating floor, operating tables, all piping and valves, replacing with new rearranged pipe, valves and controllers and rebuilding a new and wider operating floor equipped with new tables. The work was made more difficult and costly due to the fact that only half of the units could be spared out of service at one time, the other half being needed to meet consumption increase at that particular time. This job was designed, supervised and carried out by our plant forces and has resulted in very successful and economical operation of these filters for the past eleven years. This job cost $63,000 which was a saving of about $12,000 under our estimate and under a contractor's price.

Again, in 1930, a decision was made to tear out the old battery of filters, known as the Hermany Filters, built in 1909 of steel construction. After 20 years of continuous operation these units had about rusted out to the danger point. The question was raised at that time as to whether or not to let out this dismantling job to a contractor. After estimating the cost of the job and obtaining a junk dealer's price on the salvaged material, the writer decided that there should be a good saving effected, if done by our own forces. This work was finally carried out by our plant men in good time. The job cost $7,765 and the salvaged material brought us $17,000, netting the company a clear profit on the job of $9,235.

*The Louisville Water Co. is municipally owned and operated.



The New South Filters at Louisville, Replacing the Old Hermany Filters of Steel

Using Local Sand in Filters

Early in 1931, following the above-mentioned dismantling job, a contract was let to build new filter units in place of those we had torn out. In this contract it was stipulated that our company furnish, grade and place the sand and gravel. In the case of sand, the best price we obtained from filter sand dealers was $7.50 per ton delivered at the plant. A total of 1500 tons of sand was required for the six 6.0 mgd. units. At the dealer's price this would have cost $11,250 for prepared sand. We finally purchased 2,000 tons of selected local Ohio River sand at $1.50 per ton, allowing for 33 per cent wastage in scraping off the fines. The cost of placing and scraping amounted to $0.50 per ton, making the cost per ton total $2.00 and the final cost $4,000. We made, therefore, a clear saving on this item of $7,250.

Improved Methods of Cleaning Basins

The Louisville plant has two large preliminary sedimentation basins each of which covers about nine acres and holds fifty million gallons. One inch depth of mud in either of these basins is equivalent to 1,000 cu. yards. The custom had been for many years to drain each of these basins down and clean them every two or three years, the average mud content over this period being from twenty to thirty inches, or twenty to thirty thousand cubic yards.

During the nine year period of 1910-1918, six separate cleanings of one or the other of these basins were carried out. Two of these cleanings were done by a contractor and four by the water company forces under a labor foreman. The total amount of mud moved in these six cleaning operations was 155,000 cu. yds. at a total cost of $56,261.00, an average of $0.363 per cu. yd.

During the twelve year period of 1921-1932 inclusive, under the writer's supervision, six separate cleanings of these same basins have been made with a total mud removal of 182,000 cu. yds. at a total cost of $11,076 or an average unit cost of $0.061 per cu. yd. Thus, under our methods, we moved 27,000 cu. yds. more of mud in the same number of cleanings at $45,185 less cost than was done under the old methods. Figuring the two costs on the basis of the same yardage, the saving would have come to $54,890.

The improved method of cleaning, mentioned here as yielding this large saving, consisted merely of taking greater advantage of water pressure and gravity and less of main strength and awkwardness. The contractor, on his jobs, attempted to move mud deposits of from three to six feet in depth by means of a grab bucket and loading into cars on a narrow gauge track whence the material was carried up over the wall and deposited outside the basins. Later, when company foremen did the work, they improved on this somewhat by cutting the mud first with hose streams, then using labor with hand scrapers to move the mud to radial gutters and thence into the drains. Our later method consisted of using higher pressure hose streams mounted on swiveled carriers so that one man could easily handle a nozzle under 90 lbs. pressure. After the mud was cut down in large chunks by the hose stream, it was carried to the gutters by mule teams dragging V-shaped wooden scrapers handling about two cu. yds. at a time. About six hose streams were used at a time and three or four teams of mules. By this method we were able to move from 1,000 to 1,500 cu. yds. per day as against 300 to 600 cu. yds. per day by the other two methods.

Money Saving Methods in Purification Plant Operation

Following is a tabulation showing the principal features as to dates, methods, quantities and costs of these different basin cleaning operations.

The figures show that, under the improved methods, we handled 27,000 yards more mud for $45,185 less money than under old methods. On the basis of equivalent yardage we saved $54,990.

DETAILS OF OLD METHODS OF BASIN CLEANING

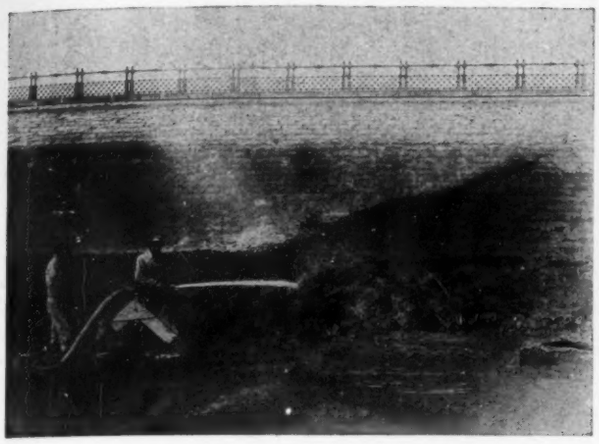
Year	Basin	By Whom	Method	Cu. Yds. Mud	Total Cost	Cost, Yd.
1910	North	Contractor	Excavation removed in cars	65,000	$31,850.00	$0.49
1911	South	Contractor	Excavation removed in cars	30,000	14,700.00	0.49
1913	North	Water Co. foreman	Hand scrapers and hose	18,000	2,805.00	0.155
1915	North	Water Co. foreman	Hand scrapers and hose	12,000	1,920.00	0.16
1915	South	Water Co. foreman	Hand scrapers and hose	9,000	1,440.00	0.16
1918	North	Water Co. foreman	Steam drag and hose	21,000	3,546.00	0.168
Six Separate Cleanings—Total				155,000	$56,261.00	*$0.363

*Average.

DETAILS OF RECENT METHODS OF BASIN CLEANING

Year	Basin	By Whom	Method	Cu. Yds. Mud	Total Cost	Cost, Yd.
1921	North	Supt. Filtration	Mules, V-scrapers and hose	30,000	$ 2,200.00	$0.073
1922	South	Supt. Filtration	Mules, V-scrapers and hose	19,000	1,370.00	0.072
1924	North	Supt. Filtration	Mules, V-scrapers and hose	22,000	1,636.00	0.074
1924	South	Supt. Filtration	Mules, V-scrapers and hose	15,000	837.00	0.056
1931	North	Supt. Filtration	Mules, V-scrapers and hose	72,000	3,562.00	0.050
1932	South	Supt. Filtration	Mules, V-scrapers and hose	24,000	1,471.00	0.061
Six Separate Cleanings—Total				182,000	$11,076.00	*$0.061

*Average.



Cleaning Settling Basins, Showing Depth of Mud and Method of Cutting. One of Six Hose Streams with 90-Lb. Pressure Behind Them

Savings Due to Change from Small to Large Chlorine Containers

In 1931 we believed our chlorine consumption sufficiently high to admit of some economy in the use of ton containers in place of the 150 lb. cylinders in use up to that time. The change was recommended, approved and made in June, 1931. New equipment installed for handling the large containers cost $1,312. Allowing for this cost plus interest and amortization, a saving of $9,132 was made by this change in the first three and one-half years of use.

SAVINGS ON USE OF TON CHLORINE CONTAINERS

80,000 lbs. chlorine per year in 150 lb. cyls. @ 6.1c	$ 4,880.00
80,000 lbs. chlorine per year in ton cyls. @ 2.19c	1,752.00
Gross saving per year	$ 3,128.00
Cost of new handling equipment plus int. and amort.	1,456.00
Net saving for first year	$1,672.00
Gross saving for 2½ years less 6% int. and 5% amort.	7,460.00
Total net saving for 3½ years	$ 9,132.00

Savings Due to Substitution of Quick Lime For Hydrated Lime

Lime is used at Louisville for removal of free CO_2 to arrest corrosion of mains and services. Pebble quick lime was substituted for hydrated lime in March, 1934. Following is a tabulated comparison of the costs of hydrated and pebble quick lime. These costs are corrected to apply in each case to a period of twelve months and to the same number of gallons of water treated.

1933—Hydrated lime, 482.7 tons @ $7.99	$ 3,856.77
1934—Quick lime—327.3 tons @ $9.07	2,968.61
Gross saving for one year	$ 888.16
Int., dep., and operating cost of slaker per year	243.00
Net saving for one year	$ 645.16

Savings Due to Installation of Flocculators

Dorr flocculators were placed in service in all three coagulation basins in December, 1933, so the year 1934 was the first full year of flocculator service. The cost of this installation was $12,000. The following table gives a comparison of alum costs in 1914, 1931 and 1934, three years of nearly the same average turbidity. In the first two years, 1914 and 1931, the old methods of mixing were in use, while in 1934 flocculators were in service. Figures for all three years are carefully corrected so as to be comparable as to amount of water treated and price of alum.

Year	Type of Mix	Average Turb.	Alum Cost	Average G.P.G.
1914	Incidental in inlet wells	72	$29,987.00	1.05
1931	Incidental in inlet wells	72	23,382.00	0.82
1934	Flocculators	64	19,119.00	0.67

Therefore, the 1934 alum cost, using flocculators, is $4,263 (18.2%) less than the best previous comparable year and is $10,868 (36.2%) less than the highest previous comparable year. The low saving of $4,263 is equivalent to a return of 35 per cent on the investment in the flocculating equipment.*

*Note: In a forthcoming article Mr. Lovejoy will discuss the flocculators and their performance more in detail.—Ed.

RESUME OF IMPORTANT SAVINGS SINCE 1921

Savings on basin cleaning methods (12 years)	$54,990.00†
Savings on filter reconstruction (1924)	12,000.00
Savings on dismantling filters (1930)	9,235.00
Savings from use of local sand (1931)	7,250.00
Savings on clorine in ton containers (3½ years)	9,132.00†
Savings from use of quick lime (1 year)	645.00†
Savings from use of flocculators (1 year)	4,263.00†
Estimated total savings for the past 15 years	$97,515.00

†Operating savings of continuous and cumulative effect.

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Arthur T. Clark Selected to Manage Morristown, N. J., Water Department

Arthour T. Clark has been appointed Manager and Engineer of the Water Department of Morristown, N. J.

For ten years Mr. Clark was Engineer and Superintendent for the Municipal Commission of Herkimer, N. Y., where he filled the duties of a City Manager. Later he was engineer for a water utilities operating company which was taken over by Federal Water Service. Then he became Chief Engineer of Supervising Engineers (Community water Service Company's construction and operating organization) and only recently has managed two important companies owned by the later organization.

A. T. Clark

Public relations, which have been none too good at Morristown, are obliged to improve along with other things as a result of Mr. Clark's appointment.

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Roger Esty Made Chairman N. E. Section A. W. W. A.

At the recent annual meeting of the New England Section of the A. W. W. A. Roger W. Esty, Supt. Water Works, Danvers, Mass., was elected Chairman.

Other officers named for 1935-36 were: Vice-Chairman—Harry W. Fuller, Portland, Me. Sec'y-Treas.—Chas. W. Mowry, Boston, Mass. Trustee Member A. W. W. A.—Frank A. McInnes, Boston, Mass. Board of Directors—Robert Spurr Weston, Boston, Mass.

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Body of Dr. Bigelow Recovered from Lake

Some months ago we printed a notice of the disappearance of and a picture of Dr. George H. Bigelow, former Commissioner of Health of Massachusetts. At the time a widespread search for him was instigated. We believe we should let our readers know that Dr. Bigelow's body was found in a reservoir in Framingham, Mass., in March of this year.

Giving Odor Nuisance the Can! Princeton's Source of Scrap for Making Iron Chloride. No Danger of Falure of Supply of Raw Materials. We Incinerate Garbage But Dispose of Tin Cans by Way of Sewage Treatment.

CHLORINATED IRON SOLVES ODOR NUISANCE AND IMPROVES DIGESTER PERFORMANCE

Experiences at Princeton, N. J., Treatment Works

By I. R. RIKER
Sanitary Engineer[1]

I. R. Riker

THE Princeton Sewage Treatment Works are located about 3½ miles north of the center of Princeton and is fed by a thirteen and a half mile gravity trunk line. At the plant site the sewage is lifted 77 ft. from a pumping station to the plant which consists of primary settling tanks, sprinkling filters, secondary sedimentation tanks and separate sludge digesters.

The plant, being located on a much traveled county road and less than one-half mile from Kingston, N. J., we have had to be very particular about odors. The plant was equipped for pre-chlorination and the process has been used to a great advantage, but we found the margin between the sulphide odors and the chlorinous (medicated) odors was so narrow that very often we were troubled with the medicated odors when an excess of chlorine was added. The chlorine solution from the prechlorinating machine enters the raw sewage force main about 400 ft. ahead of the primary settling tanks.

Chlorinated Iron Tried

After making several experiments and investigations we decided to connect up a portable chlorinator which we had in stock and use the "tin-can" method of treatment.* The chlorinator was set up at the inlet end of our primary settling tank and a 24 in. concrete pipe was placed on end in the ground on a 6 in. concrete base making a water-tight tank 24 ins. in diameter by 4 ft. in depth. This was kept filled with crushed tin cans from our incinerator and the discharge hose from the solution feed chlorinator was placed so the outlet would be in the bottom of the tank. There was a ¾-inch hole cut in the concrete pipe about 3 inches from the top for the discharge of the rising solution. A small hose was then run to the inlet of the primary tank to discharge the iron chloride solution.

Chlorine was fed through this tank at the rate of 30 lbs. per day, with water flow reduced to give a detention period of 90 minutes. Theoretically this amount of chlorine should combine with approximately 15 lbs. of iron to produce 45 lbs. of ferric chloride ($FeCl_3$). This efficiency was not attained, however, due to the limitations of the portable machine which was not built for this type of work. Improvements now planned for the coming season should bring this process up very close to 100 per cent efficiency.

A catch sample and the analysis of the discharged iron solution indicated it to contain 420 ppm of ferric

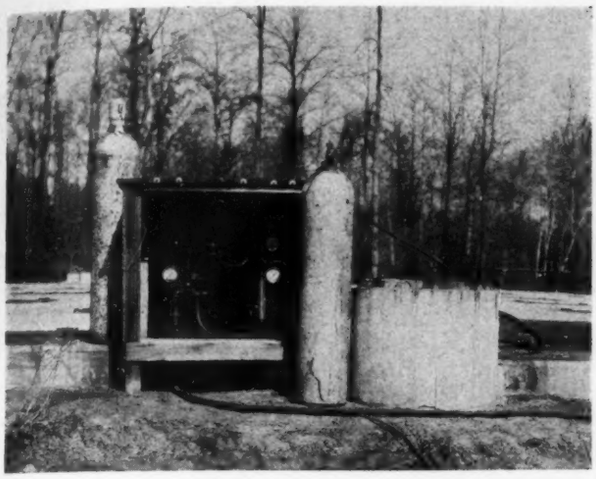
As an odor control measure possessing coincidental advantages, Mr. Riker, in this article, reveals the greater practicability and superiority of ferrous or ferric iron salts in combination with partial pre-chlorination over and above pre-chlorination alone — especially when treating stale or septic sewages of high chlorine demand. In addition to the "fixing" of volatile suphides as now the volatile iron-sulphur compounds, he points to other advantages—not the least being a better separation of a superior supernatant liquor.

Elsewhere in this issue, an article, Dr. Rudolfs and Mr. Lacy, calls attention to the likelihood of depreciation in performance of activated sludge plants when sewage pre-chlorination is practiced without due regard to its possible effects cn this sensitive process.

By simple deduction, when taking the two articles together, there appears to be genuinely sound technical reasons to expect an increasing use of iron compounds or the production of "chlorinated iron" via Mr. Riker's "tin-can process" in pre-treatment of sewages.—Ed.

*A scheme of producing ferric or ferrous chloride from tin cans and scrap iron as developed by Scott and Darcey at Oklahoma City, Okla.

[1]Supt. of Sewerage, Borough of Princeton, N. J.



1934 *Experimental Outfit for Making Iron Chloride; to Be Replaced by Permanent Installation in* 1935

chloride. There is no question but that the solution was much stronger than this at times. Very little labor was required to maintain this operation, adding tin cans and adjusting the chlorine were the only necessary duties.

Effects Observed

The application of this chlorinated iron to the crude sewage had the following effect on the plant:

1. It improved the performance of the primary settling tank.
2. Sludge digestion was improved which in turn made it more easy to decant a clearer supernatant.
3. Odor control was improved perceptibly.
4. An economy in chlorine requirement resulted.
5. The operation of our sprinkling filters improved over the preceding year when pre-chlorination alone was employed.
6. Sludge drying was improved.

Unfortunately we have no suspended solid analysis to prove our first conclusion. We could tell however from our Imhoff glass sample and from the appearance of the effluent of our primary tank that it was much improved during the application of chlorinated iron. We did not find so much material carried over into the dosing tank or on the sprinkling filter. We do have figures on the B. O. D. for each year and they show a remarkable increase in per cent removal of B. O. D. in 1934 above that of 1933.

In the early Spring of 1934 several of our digestion tanks were foaming and we had much difficulty in drawing off supernatant water. The treatment was started in May, 1934, and three or four weeks after it started the foaming stopped and we were able to obtain a definite zone of liquid between the sludge and scum. We were able to decant supernatant water satisfactorily all summer. We discontinued the treatment the early part of October, 1934. Following this shut-down the sludge digestion tanks started foaming again about the middle of November. This return of foaming likewise brought on difficulties in decanting. To us this clearly indicates the value of the treatment as far as sludge digestion is concerned. We believe the iron helped de-water the sludge, for we got better drying in 1934 than in 1933.

The treatment was principally introduced to help control the odors from sulphides already present in the sewage arriving at the plant. The iron chloride destroys existing H_2S but will not prevent its later formation. However, any excess added will be present to combine with the sulphides if later produced. Our sewage is very stale, the trunk line being 13 miles long. The average B. O. D. of the crude sewage during the summer is 225 ppm. It would be still higher if it were not for the fact that we add 10 per cent brook water to the sewage during the summer to keep the trunk line flushed out when our flow in summer, with Princeton University closed, is only about half of the winter flow.

Chlorination Experiences

The summer chlorine demand is about 25 ppm and we have had to add as high as 20 ppm of available chlorine to the raw sewage at times to control the hydrogen sulphide. We aimed to add enough chlorine so that samples of the chlorinated sewage to which methylene blue was added would retain its color 12 hours. Such a quantity of chlorine would often result in a trace of residual in the tank effluent. Due to the rapid changes in the composition of the crude sewage, we found that the maximum chlorine demand and H_2S content occurred at about eight o'clock in the evening. We changed the chlorine dose from time to time to meet the demand but even so there were times when the sewage was overdosed. We attempted split chlorination by setting up a chlorine machine at the outlet of the sedimentation tank to be used as a "vernier." We set the pre-chlorinator for the average or even the minimum dose and controlled the peaks by the "vernier" machine. This method worked better but required extra labor and was still rather uncertain.

We never got H_2S odors when using this method but about 5 per cent of the time we would still get medicated odors which of course usually occurred just when the wind was in the direction of the village of Kingston, N. J.

Combination Treatment the Solution

Last year we continued to pre-chlorinate but never enough to overdose the sewage. We took care of the peaks with the iron solution and we did not get the chlorinous odors experienced in 1933. In spite of the fact that the raw sewage had a high B. O. D. and chlorine demand, we used less chlorine in 1934 than in 1933. We did not hear a complaint all summer long.

The iron caused the surface stone in the filter to turn brown. We did not notice the continuous unloading in the effluent of the filter and the average B. O. D. was lower in 1934 than in 1933. The most remarkable change was the bacterial results. The average 37 degree count in 1934 was 219,000 per c.c. while in 1933 it was only 80,000 per c.c. which indicates to us that the chlorine alone had a much greater effect on bacterial life

What Happens in Millstone River, ¼-Mile Below Plant Outlet

At times in 1933 the sprinkling filter effluent gave a count of less than 100 per c.c. and indicated an overdosage of chlorine before the adaptation of the Scott-Darcey scheme.

Costs

The cost of this treatment (including labor) was about $2.25 per million gallons. We think so much of the method that we are planning a permanent installation which will consist of a brick house 6 ft. x 6 ft. in plan in which to house the solution feed chlorine machine. The iron tower will be outside. Permanent water lines will be run to this building to replace the hose lines. The tower capacity is to be increased by 100 per cent to increase contact period and reduce frequency of filling with scrap, and the connecting lines made permanent. I do not believe we need any control devices other than the water control valve and the chlorine control valve on the chlorinator. I do not contemplate any agitating device for the tin cans because they fall to pieces rapidly.

The same principal will apply as in the old chemical solution pot feeds for pressure filters. This control, while not so satisfactory for such plants, will meet the requirement for sewage pre-treatment where a slight over dose or under dose does not mean so much.

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Water Resources Board Names Advisory Committee

In the prospect that unemployment-relief projects by Federal, State, and local agencies may include some which will involve collection of hydrologic data, the National Resources Board through its Water Resources Section has assembled an advisory Committee on Specifications applicable to such data.

The committee was selected to represent a broad range of professional viewpoint growing out of differences in uses of data in different regions. Its members are:

Thorndike Saville, (Chairman) College of Engineering, New York University, New York City.
Donald M. Baker, Cons. Engr., Los Angeles, Cal.
H. K. Barrows, Cons. Engr., Boston, Mass.
Capt. J. P. Dean, U. S. Engineer Office, New Orleans, La.
Willis Gregg, Chief, U. S. Weather Bureau, Washington, D. C.
N. C. Grover, Chief, Water Resources Branch, U. S. G. S. Survey, Washington, D. C.
Montrose Hayes, Chief, River and Flood Division, U. S. Weather Bureau, Washington, D. C.
W. W. Horner, Cons. Engr., St. Louis, Mo.
Joseph Jacobs, Cons. Engr., Seattle, Washington.
Royce J. Tipton, Cons. Engr., Denver, Colo.
Special Consultants to the Committee are:
Robert E. Horton, Cons. Engr., Voorheesville, N. Y.
Adolph F. Meyer, Cons. Engr., Minneapolis, Minn.

The committee expects to meet in Washington during the week of June 3. In the meantime it is inviting constructive suggestions as to (a) especially important projects in extension or compilation of hydrologic data, (b) approved methodology in collection and publication, and (c) minimum qualifications for personnel employable on collection of basic data.

Brent S. Drane, Executive Engineer of the Water Resources Section of the National Resources Board, is serving as secretary to the committee.

Biological Methods of Sewage Treatment Identified with Water Softening

Recent studies, by Public Health Service workers, of the adsorption of organic matter from sewage by the so-called "activated" sludges have led to the definite identification of the adsorbent principle in activated sludge as a base-exchanging substance chemically identical with the zeolites of water purification. The process of removing organic matter from sewage by the biological slimes or activated sludges, therefore, becomes basically the same as the corresponding process of removing hardness and other objectionable constituents in a widely-used process of water purification. Detailed information on this new concept regarding an old problem will be contained in a series of papers by Public Health Service investigators soon to be published. In these papers the earlier theories of sewage clarification will be reviewed and the conclusion reached that the adsorbent principle is related not to the bacteria themselves, but to the gelatinous matrix or sludge in which they are embedded. It will next be shown by chemical analysis that the inorganic portion of the gelatinous matrix is definitely a zeolite. In continuation of the same series of papers, the behavior of activated sludge will be shown to conform rigidly to the action of a zeolite. The sterilized sludge, for example, can be regenerated by sodium chloride in exactly the same manner as the commercial zeolites. Under natural conditions, however, the regeneration of the sludge is technically called a "reactivation," with the bacteria as the active agents instead of sodium chloride. Natural sludge is, therefore, termed a "bio-zeolite." In conclusion, the clotting enzyme, or sewage colloid of the earlier chemists, will be identified with the sludge zeolite.—From U. S. P. H. S. Public Health Reports.

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World's Largest Imhoff Tank Installations Completed at Chicago

The world's largest installation of Imhoff tanks were recently placed in full operation at Chicago's West Side Sewage Treatment Plant. At the same time, ground was broken on an adjoining site for the $11,000,000 Southwest Side Sewage Treatment Plant.

Construction of the new plant and completion of the Imhoff batteries at the West Side treatment works are being financed with a portion of the PWA $42,000,000 loan and grant for sewers and treatment works. With most of the work nearing completion, the project constitutes the largest sanitary engineering job in history.

The new battery of Imhoff tanks is the third to be constructed at the West Side plant, and will increase its capacity for partial treatment to 472 million gallons daily. There are thirty-six tanks in Battery "C," with a capacity of 204 million gallons daily which cost approximately $2,700,000. Work on the battery was abandoned by the Sanitary District in 1931 because of financial difficulties but work was resumed in 1934 when PWA alloted $1,280,900 to complete the installation.

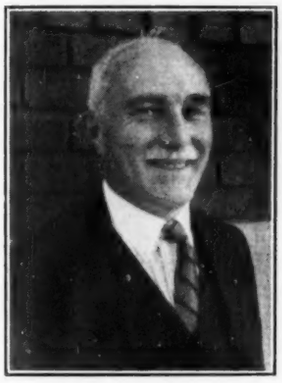
The new Southwest Side plant (activated sludge) will have a capacity of 400 m.g.d. and it is believed will cost approximately $28,000 per m.g. capacity to build. To serve 1,250,000 population 10 miles of concrete sewers are to be built in the 68-square-mile Southwest area.

EFFECT OF CHLORINE ON ACTIVATED SLUDGE*

II. Partial Chlorination

By WILLEM RUDOLFS[1] and I. O. LACY[2]

IN part 1 of this article[3], it was reported that complete chlorination of sewage and sludge mixtures to residual produced a natural reduction in the B. O. D. of the activated sludge, but when a mixture of sewage and sludge was chlorinated the B. O. D. and turbidity of the supernatant liquid increased. Naturally, the question arose as to what the effect would be (1) of partial chlorination of the sewage added to activated sludge and (2) of partially chlorinated activated sludge to which un-chlorinated sewage was added. The next question was whether the decreased oxygen requirement of the sludge could be accounted for in the increased demand of the effluent or, in other words, whether chlorine under these conditions caused an absolute and permanent reduction of the B. O. D. The findings follow:



Willem Rudolfs

Procedure

Sewage was chlorinated to the extent of 0, 30, 70 and 100 per cent of the chlorine demand. The 100 per cent chlorine demand satisfaction included 0.2 residual after 10 minutes standing. The sewage was then added to good activated sludge obtained from the Tenafly, N. J., plant. Activated sludge was chlorinated in a similar way and raw unchlorinated sewage added. The mixtures were aerated with an abundance of air for 4 hours. Determinations of 2, 4, 6, 8 and 10 day B. O. D. were made on the sewages, effluents, sludges and mixtures in addition to suspended solids, turbidity and settleability of the sludges.

*Journal Series paper N. J. Agricultural Experiment Station, New Brunswick, N. J., Dept. Water & Sewage Research.

[1]Chief, Dept. Water & Sewage Research.

[2]Asst., Dept. Water & Sewage Research.

[3]WATER WORKS AND SEWERAGE—April, 1935.

Results

A set of B. O. D. results of the effluents obtained when the sewage was chlorinated to different percentages of chlorine satisfaction is shown in table 1. It is apparent that with increased chlorine demand satisfaction of sewage and sludge the B. O. D. of the effluent increased. The effect became more apparent when the effluents were incubated longer.

The suspended solids in the mixtures were kept practically constant. The suspended solids with turbidity of the effluents are shown in table 2. Suspended solids as determined by the Gooch method showed some increase, but the increase in finely divided material in the supernatant is better shown by the increase in turbidity.

The sludge volume remained practically constant, while the 10 day B. O. D. of the sludge decreased with the increase in chlorination. It appears therefore, that partial chlorination of sewage before addition to a good activated sludge, which had not been subjected to chlorine, causes deterioration of the effluent.

Results on partial and complete chlorination of the activated sludge and subsequently mixed with raw sewage are presented in tables 3 and 4. From the set of

TABLE 1

B. O. D. of Effluent. Sewage Chlorinated, Mixed with Activated Sludge

Cl_2 Demand Satisfied	Days B. O. D. 2	4	6	8	10
Pct.	ppm.	ppm.	ppm.	ppm.	ppm.
0	8	13	19	20	20
30	8	16	20	..	30
70	12.5	17	20	36	32
100	13	18	20	41	63
Sewage	205	306	325	340	365

Note: Cl_2 demand of sewage 17.4 ppm. (0.2 ppm. after 10 min. contact).

TABLE 2

Suspended Solids After 4 Hrs. Aeration and 1 Hr. Settling (Sewage Chlorinated)

Cl_2 Demand Satisfied	Susp. Sol. in Mixtures	Susp. Sol. in Effluent	Susp. Sol. in Sludge	Turbidity Effluent	Sludge Volume	10 day B.O.D. Sludge
Pct.	ppm.	ppm.	ppm.	ppm.	Pct.	ppm.
0	2,594	10	11,150	35	22	5,520
30	2,668	10	11,670	43	22	5,425
70	2,592	12	10,440	48	22.5	4,675
100	2,596	18	11,370	54	21.5	4,605

This is the second of a series of three articles dealing with the "Effect of Chlorination on the Activated Sludge Process." The first, in our April issue, related effects of complete chlorination of sewage or sewage-sludge mixtures. This one tells of the effects of less than complete (partial) chlorination which, like complete chlorination, may result in benefits in one direction but prove harmful to the process when functioning efficiently. The third article of this series will reveal cases wherein chlorination, properly applied, may prove helpful in correcting abnormal conditions of the activated sludge process and supports experiences in actual plant scale operations wherein partial chlorination at times has proven a beneficial corrective measure.—*Editor.*

TABLE 3

B. O. D. of Effluent. Activated Sludge Chlorinated and Mixed with Sewage

Cl_2 Demand Satisfied	Days B. O. D.				
	2	4	6	8	10
Pct.	ppm.	ppm.	ppm.	ppm.	ppm.
0	23	60	94	117	95
30	140	195	235	226	253
70	132	168	194	190	195
100	123	178	171	195	300
Sewage	342	390	480	770	810

Note: Cl_2 demand of sludge 38.25 ppm. (0.2 ppm. after 10 min.).

TABLE 4

Suspended Solids After 4 Hrs. Aeration and 1 Hr. Settling—Effect of Varying Degrees of Chlorination

Cl_2 Demand Satisfied	Susp. Sol. in Mixtures	Susp. Sol. in Effluents	Susp. Sol. in Sludge	Sludge Volume
Pct.	ppm.	ppm.	ppm.	Pct.
0	2,110	48	7,780	16
30	1,616	146	8,310	13.5
70	1,412	142	7,880	13
100	1,402	166	6,550	14

B. O. D. results submitted it is clear that partial chlorination of activated sludge causes the production of a very poor effluent. When the B. O. D.'s of the chlorinated effluents are compared with those of the strong raw sewage as well as with those of the effluent produced without chlorination, the activation process was very inefficient when partial chlorination was practiced. The low chlorine demand of the activated sludge mixtures used would tend to indicate that the sludge was in a very good shape. The aeration time was kept short on purpose to accentuate the results. Nevertheless, the B. O. D. reduction was pronounced, from 80 to 85 per cent, depending upon which incubation period is taken. The results on suspended solids in the different effluents show clearly the lack of removal with partial chlorination.

The sludge volume appeared to decrease and this phase of the work will be discussed more in detail in a subsequent paper, showing the effects of different ways of chlorination upon the settling rates of the suspended

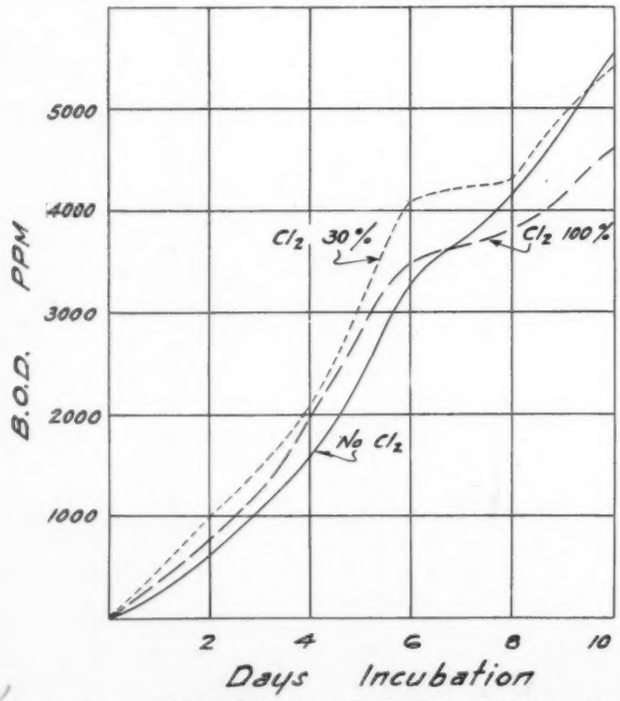


Fig. 1—Oxygen Demand Values (B. O. D.) of Sludge After Varying Degrees of Chlorination.

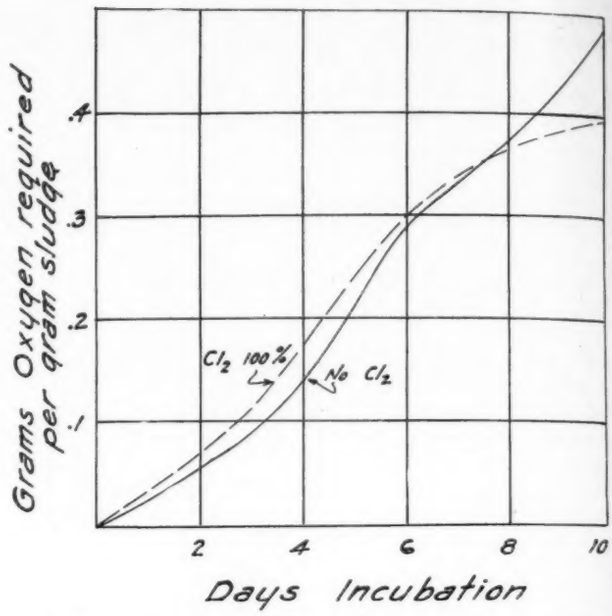


Fig. 2—Oxygen Demand of Effluent Per Gram of Suspended Solids Content of the Effluent.

solids. The sludges produced under the conditions given were continuously aerated for a period of three days. Improvement in the effluents was very little. Settling and compacting after this prolonged aeration of the chlorinated sludges improved somewhat. The chlorinated sludge mixtures filtered and dewatered more rapidly than the un-chlorinated. Without chlorination the sludge rose more rapidly to the surface, upon quiescent standing, than the chlorinated sludges. The chlorinated mixtures showed considerably more foam on the surface during aeration and the amount of foam appeared to be in direct proportion to the quantity of chlorine added. The floc of the chlorinated samples was less irregular, more rounded and looked "drier." The odor was more bitter, while the effluents had a brownish color, similar to weak solutions of humic acids. The sludge floc was lighter in color and bleached.

Discussion

The laboratory results presented on partial chlorination of sewage and activated sludge indicate a progressive decrease in clarification and purification by the activated sludge process. The effect of partial chlorination of the activated sludge proper is greater, probably due to the fact that the chlorine demand of the sludge was greater. The amount of chlorine added to the sewage to satisfy the demand was 0.67 mgrms. of chlorine per gram of dry suspended solids whereas the quantity added to the sludge amounted to 2.70 mgr. per gram of dry suspended solids. The decrease in clarification and purification produced by the chlorinated sludge as compared with the decrease when the sewage only was chlorinated is, therefore, directly in line with the progressive decrease in purification caused by partial chlorination. In other words, no matter whether the chlorine is added to the sewage of the sludge, poorer results may be expected as the amount of chlorine added is increased.

As indicated in the tables, the oxygen requirements of the effluent and sludges change with the chlorine dosages. If the oxygen requirements of the effluents increase in proportion to the decrease in the oxygen demand of the sludge, a simple displacement would have taken place. If, on the other hand, the total oxygen

requirements of the effluent and the sludge would be less when chlorination is practiced, it could be assumed that the chlorine caused a definite and permanent reduction in B. O. D. It is also of interest to know whether there is a relationship between the quantity of chlorine added and the reduction in oxygen requirement, or whether the chlorine would affect only a certain fraction of the material having the most immediate oxygen demand.

Plotting the B. O. D. of the sludge and the B. O. D. of the effluent an indication is obtained of what appears to happen. The B. O. D. of the sludge taken from chlorinated sewage is shown in fig. 1. The curves show that during the first 6 days of incubation the B. O. D. of the sludge was higher than of the sludge receiving unchlorinated sewage, while that from partially chlorinated sewage remained higher until nearly the end of incubation. The effluent showed a very similar behavior (fig. 2). The B. O. D.'s of the effluent from partially chlorinated sewage fell between the curves for no chlorine and complete satisfaction of the chlorine demand of the sewage.

Calculation of the increase and decrease in oxygen requirements of the effluents and sludges during the different incubation periods show some very interesting results. In table 5 the oxygen requirements in milligrams per liter sludge plus effluent are presented for the unchlorinated material, while for the chlorinated mixtures the increases or decreases in oxygen requirement are given. The effect of chlorine apparently is, first, to increase the quantities of oxygen required, and secondly, decrease the quantities of oxygen required with the time of incubation. The ultimate result is an absolute decrease in oxygen necessary. However, if only the 5 day B. O. D. results are considered, the oxygen requirement seems to be increased. It is evident also, that at least a part of the material with the greatest short period oxygen requirement moves from the sludge to the effluent when partial or complete chlorination of activated sludge is practiced. In order to show the percentages increase and decrease of oxygen requirement during the different periods of incubation with complete and partial chlorination the results have been tabulated (table 6). The 10 day oxygen demand decreased with the amount of chlorine added approximately in proportion to the quantity of chlorine added.

TABLE 5

Oxygen Requirements of Effluent and Sludge During Different Incubation Periods

Days Incubation	Grams Cl_2 Added Per Gram Suspended Solids: Effluent B.O.D. ppm.	Sludge B.O.D. ppm.	—0 O_2 Required mgr.	0.20 Increase or Decrease mgr.	0.49 Increase or Decrease mgr.	0.67 Increase or Decrease mgr.
2	8	630	150.3	79.7	65.0	50.9
4	13	1,600	396.7	101.0	107.3	80.9
6	19	3,300	815.4	168.0	14.1	7.3
8	20	4,150	1,034.0	— 6.7	— 16.2	— 9.1
10	20	5,520	1,356.8	— 47.9	—102.1	—208.1

Note: Mgrs. oxygen required per liter mixture. — Indicates decrease.

TABLE 6

Percentages Increase or Decrease of Oxygen Requirement—Varying Degrees of Chlorination

Days of Incubation	Pct. Cl_2 Demand Satisfied —30	70	100
2	53	43	34
4	25	27	20
6	20	1.7	0.9
8	— 0.6	— 1.5	— 0.8
10	— 3.5	— 7.5	—15.3

— Indicates decrease.

When the activated sludge alone is chlorinated the effluent contains greater quantities of materials requiring oxygen than when only the sewage is chlorinated, and still greater quantities than when no chlorination is practiced (table 3). In other words, with the increase in chlorine added the materials present in the effluent which require oxygen increase. This increase may be caused by disintegration of sewage particles as well as by disintegration of activated sludge particles. In addition the changes produced in the activated sludge floc result in its failure to remove as much of the colloidal material from the sewage added. The mechanism of the changes will be discussed in a later paper when settling and compacting of sludge is taken into consideration.

In a previous publication of the series[3], that complete chlorination of sludge—sewage mixtures was stated to be a dangerous tool in the control of the activated sludge process and that condition of the sludge and its character must be known before this tool can be effectively used. This warning must also be extended to (1) partial chlorination, (2) chlorination of sewage before mixing wtih activated sludge, and (3) chlorination of sludge before mixing with sewage.

Attention should be drawn to the fact that all experiments were made in the laboratory and were conducted with a good activated sludge. The effect of chlorine on poor activated sludge, especially with extreme small quantities of chlorine may be entirely different, on account of the sterilizing effect of the chlorine on undesirable organisms. Results on the effect of bacteria in activated sludge, together with other results will be presented in a following paper.

Summary and Conclusions

Sewage was chlorinated before mixing with activated sludge and also activated sludge was chlorinated before mixing with fresh sewage to the extent of 0, 30, 70 and 100 per cent of the chlorine demands of each. The B. O. D. and turbidity of the effluents increased with chlorination as did also the suspended solids, as determined by the Gooch method. Chlorination of sludges caused poorer effluents than did chlorination of the sewage. The chlorinated sludge mixtures filtered and dewatered more rapidly than the unchlorinated. The oxygen requirements of the effluent and sludges changed with the chlorine dosages. Depending upon the incubation time there was an absolute increase or decrease. Based on 5 day B. O. D. values, the oxygen requirements would appear to have increased, whereas, after a 10 day incubation period there was observed an absolute decrease in oxygen requirement as the result of chlorination. The absolute decrease in oxygen requirement was approximately in proportion to the amount of chlorine added. Calculations show that the increase in suspended solids and B. O. D. in the effluents was caused by a dispersion of materials from the sludge into the supernatant—which materials have a higher oxygen requirement.

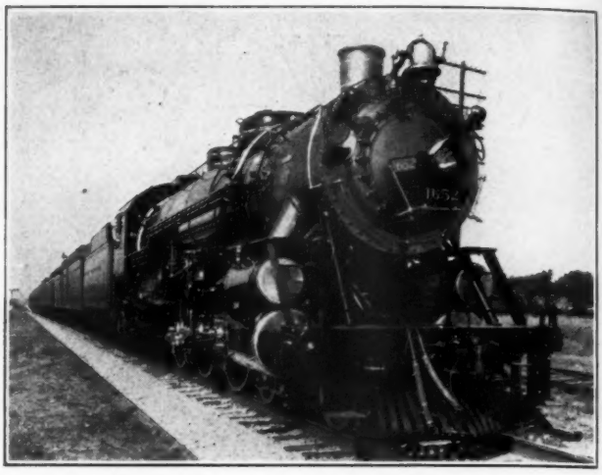
The conclusions drawn are:

(1) Like complete chlorination, partial chlorination may be a dangerous "tool" to use in control measures.

(2) Chlorination of sewage before mixing with activated sludge, as well as chlorination of sludge before mixing with sewage, produces poorer effluent.

(3) The effect of chlorination appears to be in proportion to the amount of chlorine added.

[3]Water Works and Sewerage—April, 1935.

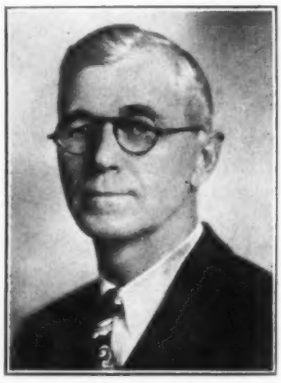


Good Boiler Water Is Essential in Maintaining Fast Schedules by Crack Trains

REVIEWING BOILER WATER CONDITIONS

By O. L. ANDERSON
*Supervisor of Water Treatment**

IT IS probably realized by but few, that water used on a railroad system, exceeds both in volume and weight, all other supplies and commodities added together. The cost of furnishing an adequate water supply for a railroad system actually amounts to approximately one per cent of the operating expenses of the system.



O. L. Anderson

Early in the operation of the Atlantic Coast Line Railroad through the southeastern states, it was realized that for economical and successful operation, some form of water treatment for steam boilers would be necessary. As early as 1906 several small lime and soda ash water softeners were built. These were erected at what was then considered the most strategic points. This was about the time that water treatment first began to gain the attention of American railroads. Since then, of course, many different schemes have been advanced for the improvement of water for steam boiler use and probably the greatest advancement along this line has been made in the past ten years.

Water treatment properly applied can be depended upon to lower boiler maintenance cost, decrease fuel consumption, cut down engine failures and increase locomotive earning capacity.

Resultant substantial savings in operating due to treatment are now established facts and heavy curtailment of expenses during the past three years has focused attention on this and all other possible economies. Length and speed of trains have been increased. Stops for water are made as seldom as possible. The increased distance between water stations permits selection of better quality supplies, requiring fewer treating plants to properly condition the water for an entire division. Wherever good boiler water can be purchased or otherwise secured at reasonable cost, of course it is much to be preferred; however, there is comparatively little natural water found which may not be improved by proper treatment. With increased size of locomotive boilers, higher steam pressures, faster schedules and heavier trains, the demand is ever increasing for better boiler water.

A point of particular interest where improved boiler feed water has shown striking results is at our Jacksonville Shops. Here the natural water has an average hardness of approximately eighteen grains per gallon—about eleven grains of which is sulphate or permanent hardness. The source of supply at this point is two wells (approximately 900 ft. deep) with sufficient artesian pressure to raise the water several feet above ground level and into two reservoirs, from which it is then pumped to the treating plant by means of electrically driven centrifugal pumps. Water at Jacksonville Shops is now all treated with lime, soda ash and sodium aluminate.

Before treated water was used in the stationary boilers at this point it was found necessary to clean and renew flues in these boilers every year. Several years ago these boilers were put on treated water exclusively. In 1933 the flues were removed from one of these boilers after five years of service and only a small accumulation of scale was found and the boiler otherwise was in good condition. As all other conditions were practically the same the four years' increase in the life of the flues must be attributed to the use of treated water. Locomotives working in the vicinity of the Jacksonville shops and beyond the reach of treated water benefit in proportion to the amount of treated water they use.

Control of Corrosion and Pitting

No other state through which the Atlantic Coast Line operates presents such a difficult problem as does the

*Atlantic Coast Line R. R. Co., Jacksonville, Fla.

A Costly Disease: A Badly Pitted Tube. Properly Treated Water Has Eliminated Such as This.

A Bad Actor: Silica Scale Collected from the Vicinity of Savannah, Ga. Now Prevented from Forming by Using Sodium Aluminate in the Boilers.

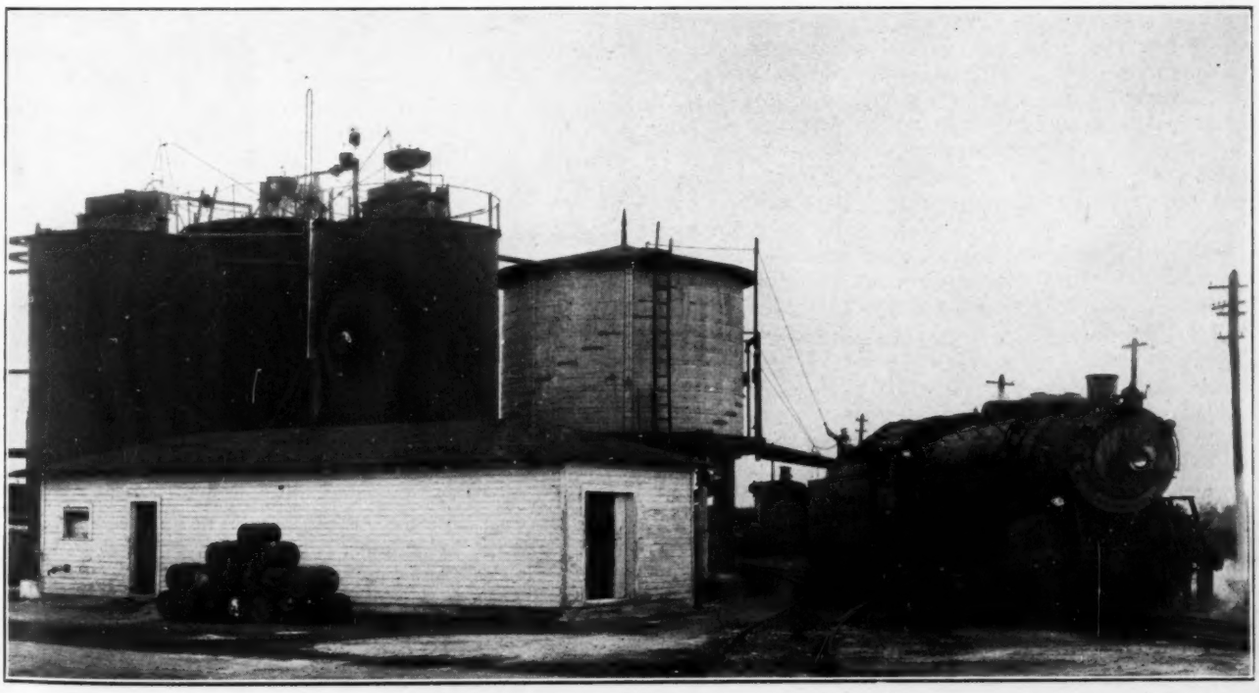
state of Florida in supplying good quality boiler water. Two problems are met with, heavy scale deposition or pitting and corrosion—the latter a trouble only second to that of scale. The corrosion and pitting problem has come to be a serious and expensive one on several divisions. Such troubles can be overcome and have been eliminated entirely at points where proper treatment has been applied regularly and consistently. A very good example has been the experiences at Goldsboro, N. C. Early in 1929 it was discovered that a very bad pitting and corroding condition existed in the yard engines wherein a set of flues had been completely destroyed in ten months' time. The water supply at this point is from a number of shallow wells scattered over a considerable area. On examination it was found that the water contained only about five to seven grains of total solids and only about four grains of hardness while the pH value varied from 4.8 to 6.5.

A light internal treatment, consisting of soda ash and sodium aluminate, was recommended for use in the boilers at this point. Consistent use of the treatment has fully eliminated the pitting trouble. The length of service of flues has been extended from the 10 months to the full time allowed by government regulation. The cost of such treatment has been so small as to be almost negligible.

Another place where treatment has entirely eliminated pitting and corrosion is in the tug boat boilers at Norfolk, Virginia. Pitting developed in these boilers to an alarming extent before it was realized. A thorough investigation was made of the situation and it was decided to use internal treatment consisting of soda ash and sodium aluminate. Now samples of the boiler water are sent into our laboratory at Jacksonville every week, where they are checked to determine the treatment and also the salt content. If the latter be unduly high, it usually indicates a leak in the condenser. Such matters are immediately reported and the condenser is "worked up." In this way salt water entering the boilers is kept at a minimum. Treatment in the tug boat boilers has been in service approximately six years and apparently the pitting has been completely arrested. The boilers also remain in good condition otherwise, being practically clear of all objectionable scale matter.

Wayside Treatment, Economical and Flexible

During the past two years considerable study has been given to wayside treating plants because this type of plant is particularly well adapted to some waters. It is inexpensive to buy, cheaply installed and easily moved if necessity demands. The initial wayside treatment plant on the Atlantic Coast Line Railroad was installed at Montgomery, Ala., in November, 1933. With treated water now available for all purposes at this point, it is expected that life of flues will be extended to the full time allowed by the government. Formerly flues have been known to have been entirely destroyed and fire boxes seriously damaged by pitting and corrosion in twelve months' time while in service on the Montgomery yard. Power plant boilers at Montgomery shops have suffered similar consequences. New power plant boilers were installed in 1924. After three and one-half years the flues had to be removed and practically the entire number scrapped. New flues were installed and treat-



A. C. L. Railway Water Treatment Station at Jacksonville.

ment started. The treatment was applied directly to the boilers until the wayside treating plant was installed in 1933. Although it has now been approximately six years since the present set of flues were installed, a recent inspection revealed that the boilers were in excellent condition, being practically clear of scale and no evidences of pitting could be found. There has been little, if any, boiler work done in this plant since treatment has been in use.

The Montgomery water is neither high in hardness nor total solids but its pH value is low. The treatment consists of adding caustic soda, sodium aluminate (No. 2) and a small amount of tannin. Sufficient of the treatment chemicals are added to insure at least two grains of alkalinity over the hardness in the treated water. Two wells supply a somewhat different character of water, have separate pumps of different types and capacity which may be used in unison or independently. It was therefore necessary to install two wayside plants, since under the particular conditions it was thought advisable to treat the water as it was pumped to the storage tank instead of applying the treatment as the water left the tank.

A second wayside plan was installed at Marion, Fla., in June, 1934. The water at this point is procured from an open well. The well is approximately thirty feet deep, by twenty feet square and is curbed with concrete. Water from such wells is largely seepage. Marion is the principal water station on the one hundred thirty mile division between Waycross, Ga., and High Springs, Fla. Until such time as additional treating plants are installed on this division, the treatment is carried somewhat higher than it ordinarily would be in order to provide some treatment of other water used on the division, so far without treatment. The same treatment is used at Marion as at Montgomery. While considerable overtreatment is carried, no complaint has so far been registered concerning any foaming or other operating troubles.

A few years ago The Atlantic Coast Line Railroad Company extended its lines from Tampa to Sarasota, Fla.—a distance of fifty miles. It became necessary to have a water station at Sarasota and since all creeks and inlets in that vicinity are contaminated with salt water from the bay, it was decided that a small open well would suffice for the time being. Business soon increased to where such a source of water supply became inadequate and a deep well was put down. Water from the deep well, while sufficient in quantity, was anything but desirable in quality. Being high in magnesium and calcium salts, it not only soon filled the boilers with hard scale but the magnesium caused no end of trouble from leaky flues and staybolts, making it necessary to "work up" the boilers after each trip. Six to twelve months was usually the life of a set of flues. Treating water of this character was not economically practical or advisable if any other solution could be devised.

After many months of what might be termed a period of continuous nightmares for the master mechanic and round house foreman, a survey was undertaken by a member of the water supply department and the writer. Water samples were gathered from all available sources near the right of way, including new test wells for a distance of about five miles either side of the Sarasota station. Results of samples analyzed proved discouraging to such an extent that hope was almost given up of finding even a fair quality of boiler water. Eventually a point about one mile from the old water station was found where a private development for industrial purposes was being worked a short distance from the right of way. Here a well had been dug to supply water for the development. A sample was taken from the well and analyzed. The results were so encouraging that a test well was put down on the railroad property opposite the development. Tests of the water at different depths were made to determine the limit of depth to which the well might be carried before encountering undesirable water. Eighteen feet was found to be the maximum depth advisable. Water production per unit area at this depth was so small that it was soon evident that a considerable storage below ground level would be imperative. Subsequent plans were made and arrangements provided for excavating along right of way to form an infiltration reservoir approximately five hundred feet long, forty feet wide and sixteen feet deep. While there have been some very dry spells during the winter and spring months since this supply was put in service, there has never been a shortage of water. Troubles on this line traceable to bad water began to show marked improvement almost immediately after beginning the use of the new supply and have almost entirely disappeared. Savings to the company in boiler maintenance have been a very appreciable figure. While such a source as here mentioned may be developed to supply small consumption it is usually inadequate for terminals or points of heavy traffic. For large demands, treatment must be resorted to for satisfactory service.

In addition to the points mentioned, there are many others on the Atlantic Coast Line where water treatment is used. It is the policy of the company to consider carefully the needs of water treatment at the various points. It has been found more profitable and by far more satisfactory to deal with reputable concerns, who have established themselves in the field of railroad water treatment by accomplishing satisfactory results on various railroads of the country, rather than apply methods vigorously promoted by purveyors of cure-all water treatment who promise much but in reality accomplish little. A careful investigation of water supplies under consideration and selection of treatment which will scientifically accomplish worth while results at economical costs is that ounce of prevention worth many pounds of the "cure."

Bill Orchard Honored by Wallace & Tiernan Employes

W. J. Orchard

On April 15th a genuine surprise party was tendered W. J. (Bill) Orchard, General Sales Manager of the Wallace and Tiernan Company, Newark, N. J.

The reason for this surprise party was the celebration and acknowledgment of twenty (20) fruitful years of service by Orchard with the Wallace and Tiernan Company. Twenty years ago he left the position of Assistant Sanitary Engineer with the New Jersey State Department of Health, with the intent of trying to sell the "new-fangled idea" of safeguarding water supplies and disinfecting sewage by chlorination. That he has been successful in his endeavor is attested by the world-wide reputation and the size of Wallace and Tiernan Company.

As a token of appreciation, Wallace and Tiernan employes presented Orchard with a handsome platinum watch and chain, but this will not help Bill get in more hours or hard licks in his extraordinary work day.

A.W.W.A. CONVENTION AT CINCINNATI AN OUTSTANDING ONE

Los Angeles Voted the 1936 Convention

BEYOND any question the 55th Annual Convention of the American Water Works Association, held at Cincinnati, May 6th-10th, was in all respects the outstanding convention of this association since that held in Chicago in 1927.

Starting off with a bang, the pace was held throughout. The official registration was more than 900 with an estimated attendance of 1,200 or more. In quality the convention was even more successful than is indicated by attendance records; for, in keeping with the times there was in evidence a general feeling that the water works industry had entered another period of generally improving conditions.

Impressive were the members in attendance from distant points, a large group having come from Texas to represent the New Southwest Section, formerly the Southwest Water Works Association. Canada and California were likewise well represented. The member coming the greatest distance probably was J. F. Kunesh, Assistant Chief Engineer of the Board of Water Supply of Honolulu.

New Officers

The following were elected to serve the Association during the coming year:

President—Frank A. Barbour, Boston, Mass.

Treasurer—W. W. Brush, New York City.

As Chairmen of Divisions

Management and Operation—Wm. W. Hurlbut, Los Angeles, Calif.

Water Purification—A. E. Berry, Toronto, Ont.

Finance & Accounting—Lewis D. Blum, New York City.

F. G. Cunningham, who has for several years served as a Director and Chairman of the Committee on Publications, asked to be relieved. To these two positions Linn H. Enslow was appointed by the Board of Directors.

Awards and Honors

Honorary Membership was conferred on William F. Molis, Superintendent of Water Works, Muscatine, Ia., (member since 1882) and Dennis F. O'Brien of the A. P. Smith Manufacturing Company of East Orange, N. J., who has been an associate member since 1897 and has for several years served on the Board of Directors as the representative of the Water Works Manufacturers Association.

The John M. Diven Medal was presented to Linn H. Enslow, Editor of WATER WORKS AND SEWERAGE, as that member who had performed outstanding services to the association.

To Dr. Frank E. Hale, Director of Laboratories, Department of Water Supply, New York City, went the John M. Goodell Prize for the work performed and its presentation in his paper before the 1934 Convention, "Pipe Corrosion Experiments, Catskill supply of New York City" which appeared in the October, 1934, issue of the Journal of the A. W. W. A.

H. E. Jordan, Retiring President.

Frank A. Barbour, President of A.W.W.A.

The recently established Virginia Section won the Nicholas S. Hill Cup for having secured the largest percentage increase in members during the year. E. F. Dugger accepted the award as Director of the Virginia Section. The Montana Section won the Franklin Henshaw Cup which is a recent prize going to that Section showing the highest percentage of active operating members in attendance at annual meetings.

H. E. Jordan, Retiring President, and W. J. Orchard, Chairman of the Entertainment Committee, were commissioned "Kentucky Colonels" by the Governor of Kentucky.

George W. Fuller Eulogized

In memory of deceased members who had passed away during the past year, President Jordan read off their names with a brief statement of achievements. Among them was the name of Myron Reynolds, M. M. O'Shaughnessy, Alexander Milne, William Gore, Burt Hodgman, Geo. W. Fuller—the last two having especially endeared themselves to the association for their services and examples.

Then followed a special memorial to George W. Fuller, which was delivered by Col. Willard Chevalier, a long-time friend of that marvelous leader who for many years was a guiding power in the association. The accomplishments of Mr. Fuller were reviewed from his pioneering researches in water purification and sewage treatment to his closing years as the fearless "activator," the ideal executive and the most practical phychologist that he was. Above all, said Col. Chevalier, he liked to think of this great man as "Fuller, the Human Being"; for, this amongst all his attributes he always was and thus remained to the end. Among his many honors he had served as president of the A. W. W. A., the A. P.

J. F. Kunesh, Asst. Chief Engineer, Board of Water Supply, Honolulu.

Host to the 1936 Convention: Wm. W. Hurlbut of Los Angeles Water Department, Worked hard for the 1936 Convention—got it.

H. A., and was the first recipient of the Diven Medal.

Following the address, a motion was made on the floor, and carried, to establish a committee to evolve an appropriate method of commemorating the name of George W. Fuller within the A. W. W. A.—for which he did so much.

New Jersey Section to Be Established

The Board of Directors voted that a New Jersey Section of the Association be established. Heretofore, members in Northern New Jersey have been affiliated with the New York Section and those in the central and southern part of the state have been affiliated with the Four States Section (N. J., Del., Pa., Md., D. C.). Henceforth, New Jersey will have its own distinctive section, as warranted by the existing and potential membership within the state.

Report of Secretary and Treasurer

The report of Secretary B. C. Little and Treasurer W. W. Brush revealed the following: Membership had been increasing during 1934 and 1935 with 2350 members on January 1st, having been increased by 104 during January, February and March and by 300 during April. The large April increase had been due to the work of the Special Membership Committee headed by Chas. Eastwood and funds had been voted to continue this work.

The cost of running the association in 1934, with its 20 Sections, had been $770.00 less than the income of $60,000—the latter being composed of $15,000 from advertisers in the Journal and $25,500 in the form of annual dues. Assets of the association included $35,000 in bonds which would be drawn upon in preparation of the forthcoming revision of the Manual on Water Works Practice. The cost of putting out the Journal in 1934 had been $16,500. Salaries paid had amounted to $22,000.

Mr. Brush reported that a $68,445 budget had been set up for 1935. Of this $62,535 was for normal expenses and $5,910 was for extra expenses, including $3,000 for printing M. N. Baker's "History of Water Purification in America"; $1,200 for a continued membership drive and the balance for other special committee work and office expense.

Electric Grounding to Water Pipes Disapproved

A resolution was offered which called attention to previous approval of grounding electrical household circuits to water pipes. Since recent evidence pointed to the hazard to maintenance of water works equipment and to safety of employees it was resolved "that all previous acceptances or approvals of such practice be revoked" by Water Companies or Water Departments. This resolution offered by N. S. Hill, Jr., carried by unanimous vote.

Water Planning for the Nation: A Featured Topic

In presenting a masterful thesis on the subject of the future handling of the Nation's water problem and its effects, Morris L. Cooke, Consulting Engineer of Philadelphia (former Director of Water Resources Section of the National Resources Board) left the following ideas with his audience. Land control and water control went hand in hand and the Work Relief program offered a challenge to the engineering profession in bringing about survival of the Nation which was wasting its natural agricultural resources through dust storms and erosion at a rate which would completely impoverish, if not starve out, the Nation within 100 years. He pointed out the need for guidance in the national plan of resources control by a group of water-engineers who are able to weigh political as well as hydraulic effects. Each individual water project must be considered, regardless of its size, a part of the general plan for water use and control. And, dams were but units and work on the stream only one aspect of watershed protection. Commercial developments had involved the harnessing and control of great waters but it was more important socially to now consider the control of "little waters"—those responsible for sapping soil fertility by surface scour. The former we knew considerable about but much less about

On the "Island Queen"

From left: 1. Dr. and Mrs. Frank Hale (New York). 2. Tom Sinker (St. Louis) gets a pointer from Mrs. John Pritchard (St. Louis). 3. John J. Quinn (a new director) and Mrs. Quinn (Knoxville, Tenn.). 4. A part of the Texas delegation—the John Winders and the Egmont Smiths of Dallas; the A. M. Brunekes of Dennison; the George Rohans and Miss Nancy of Waco.

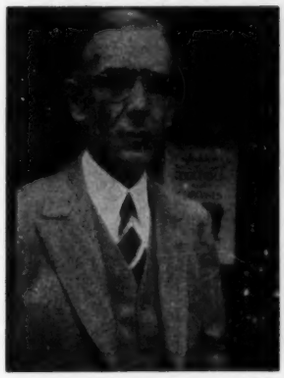
the small dams and myriads of needed reservoirs to control erosion and ground water tables. Along with quantitative control would come a water quality control so much needed at many points, and, too, reforestation and erosion control must go hand in hand with water course control.

Mr. Cooke advocated a 20-year program involving expenditure of $500,000,000 annually to fight off the creeping disease of soil impoverishment and water supply deficiencies. Such a sum, he remarked, was but a fraction of the cost of crime in America. Bold planning seemed essential and if the engineer failed at this time, who then would lead?

"Deficiencies in Present Water Resources Information" was the topic on which THORNDIKE SAVILLE spoke. Mr. Saville, who is Professor of Hydraulic and Sanitary Engineering at New York University, served as Executive Engineer of the Water Resources Section of the National Resources Board in Washington, D. C. He pointed out the 12 major uses to which our water resources are put and referred to the recent reports of the National Resources Board and the Mississippi Valley Report which deal with the Nation's water problems and relationship to water supply from surface or sub-surface sources. He drew attention to the lack of sufficient data pertaining to stream flow, precipitation, evaporation, ground water levels, yields, and chemical quality of supplies had also been rather spottily determined. The 3,000 existing stream gaging stations and 100 evaporation recording stations were woefully inadequate. Since 50 per cent of the public water supply was being taken from the ground, more adequate knowledge of this source was badly needed. He advocated that a non-bureaucratic Central Authority be established to collect, coordinate and publish information to operate a comprehensive program of hydrological research for use in future planning.

FRANK A. BARBOUR as president-elect of the association, endorsed both papers, saying that Federal control seemed the most practical method. The most immediately essential appeared to be a further investigation under a national planning agency. Careful planning of a definite procedure of coordinating regional state, local agencies with the central federal authority would be essential to success. He thought the association should assist in evolving and prosecuting a national program.

ABEL WOLMAN was of the opinion that Mr. Cooke's paper was in essence a "navigation chart" of such importance to the water outlook and vitality of the nation that it cannot be ignored regardless of detail or politics and with certainty planning could not be further delayed if a national calamity was to be prevented. One hundred years or less of vital existence was not a pleasant thought to face and as an example the shell fish industry had been through such a lack of planning and control with the inevitable result of suffering practical ruin in much less time. Wolman pointed out that glaciers had been receding and deserts growing during the past several years.



Clarence Bahlman, Supt. of Filtration at Cincinnati.

J. W. Ellms of Cleveland, was the first Supt. of Purification at Cincinnati. Learned enough to write a book on filtration.

Commenting on Saville's paper he compared the superior meteoriological records of England with those of America. As to the matter of Federal vs. local autonomy, he pointed out that bacteria do not differentiate between political faiths nor state boundaries and it appeared necessary that the importance of the latter must disappear in some instances, for a broader aspect involving combinations of local and Federal agencies. A definite precedent of such arrangements could be found in England and Germany where Rivers and Drainage Boards had been established. Grants could come from a central authority and operation be conducted by local authorities. He believed case records could be established in selected areas and also that the association could not afford to overlook endorsement and participation in any future planning.

A Resolution

MALCOLM PIRNIE rose to endorse what had been suggested and offered a resolution to this end, which carried. In essence, the resolution of the association endorsed an adequate water supply policy and offered to cooperate with the National Resources Board and other Federal authorities in evaluating and planning action to develop and effectuate such a policy and plan immedi-

On the "Island Queen"

From left: 1. W. W. Brush (New York) and Frank Speller (Pittsburgh). 2. "The Ohio Conference"—Von Arnum (Youngstown). Furman (Toledo), Lawrence (Cleveland), and Mr. What's-his-name, also from Ohio. 3. R. S. Rankin and Frank Bachmann of Chicago. On the bench is Mrs. Bachmann and "friend." 4. A lady eating candy; Mrs. Tom "Q" Wolfe (Chicago) and Mrs. Tom Veatch (Kansas City).

A. S. Hibbs, General Supt., Water Department of Cincinnati, Host and Chairman of Cincinnati Convention Committee.

The Cutest Thing at the Convention. Miss Nancy Rohan, daughter of George Rohan, Supt. of Water Works at Waco, Texas.

ately. A committee of 5 members is to be named immediately to investigate and offer the assistance of the association in future work.

Major Hawley's Moving Pictures a High Light

A highlight of the convention was the films of a variety of water micro-organisms shown and described by Major John B. Hawley of Fort Worth, Texas, who has devoted a considerable part of his life to this hobby of studying and filming water life in action. Without question these films are the finest of their kind in existence and through the Major's courtesy we are allowed to say that copies may be made by colleges or universities without charge beyond the actual cost of preparation.

Following the film showing, the Major described "The Water Works of Paris, France," which involves a triple system (a) Mountain Springs brought in through a very old 300-mile aqueduct; (b) Filtered river water from three plants operating as rapid rate slow sand plants. (c) Supply for street and sewer flushing taken from the canal without treatment. Major Hawley commented on the excellence of French engineering and the seemingly poor methods of water treatment with obsolete equipment which, however, turned out a good quality of water. Metering, he said, had been more accurately done than in America, with every drop passing the meters registering down to 1 liter per day. The rate schedule proved almost exactly that of Fort Worth, Tex. —starting at 25 cents for the first 1,000 gals. He said that they had a very ingenious method of chlorinating, involving homeopathic dosages of hypochlorite, but depended upon liquid chlorine and American chlorinators to insure an efficient job of sterilization.

Pirnie on P.W.A.

Malcolm Pirnie, immediate past-president of the association and vice-chairman of the Construction League of America, who has been so closely associated with PWA developments as an A. W. W. A. representative, reported on the "Current Situation in the Public Works Program." To date, he said, there had been no change in the 4 per cent interest rate and the 30 per cent grant allowed by the Public Works Administration and at present a PWA loan was not as attractive as that from private sources with normal procedures. Whatever the future PWA program offered it would not suffice and projects must for the most part proceed through normal channels. Revenue bonds having been held legal with low interest rates, provided the lowest cost financing. Whether a CWA or a PWA financing scheme be offered in some modification later, it was a fact that only the adequately planned projects would receive prompt recognition.

Mr. Pirnie quoted from the Construction League document of April 7th, which sets forth in detail the principles of Work Relief recommended by the League. It stressed the fact that for efficiency and economy only qualified persons should be used on work relief construction projects and at or nearly at private rates of pay. The use of a single employment service on projects was advocated. Supervision of design and construction should be given by qualified engineering firms or architects selected through local boards of engineers to serve on a fee or percentage basis. The retained firm should decide the completency of relief workers supplied. Contracts should be lump sum competitive contracts and contractors be allowed to employ a supervisory force and dismiss all incompetent relief workers supplied him. Materials should be purchased in a normal manner and if purchases be made by the government direct only standard items in car lots should be so bought.

Mr. Pirnie said that in the new program to speed up water works and sewerage projects it had been suggested to the PWA, and favorably considered, that grants in the nature of a bonus be made large for the remainder of this year and tapered off thereafter. For instance:

Until January 1st, 1936—projects to receive a 50 per cent grant.

January, 1936, to Sept., 1936—projects to receive a 30 per cent grant.

Thereafter—projects to receive a 20 per cent grant.

Mr. Pirnie, in reply to a question, said that it looked now as though the large bonus suggested for the remainder of 1935 would be favorably accepted but it would be limited to adequately planned projects ready

On the Boat Trip

From left: 1. Clint Inglee (New York), Jack O'Leary (Pittsburgh), John Warde (New York). 2. H. P. Boncher (Bradford, Pa.), Miss Wallace (Cleveland), Jimmy Angell (New York). 3. Jack Diven (New York), Jim Barker (San Francisco). 4. Tom Amiss (Shreveport, La.), R. N. Allen (Shreveport, La.).

Some of the Big Shots

Guy Northrop, President W. W. Mfrs. Assn.; Earl A. Munyon, Vice Chairman Cincinnati Convention Committee; Bill Orchard, Chairman of Entertainment; Beck Little, Secretary of A. W. W. A.; Charlie Eastwood, Chairman Membership and Publicity Committee.

to start construction immediately or within a reasonable time.

Future of American Cities

"The Future Growth of American Cities" was discussed in a masterful and engaging manner by C. A. DYKSTRA, City Manager, Cincinnati, O. He foresaw the trend away from increased growth of the larger cities, whereas decentralization of industry would result in the growth of the small cities into places to live as well as to work with more leisure demanding greater appreciation and demands for more comfortable quarters, more homes with gardens and attractive surroundings. In a world of machines, cities would necessarily disintegrate and die if the loss of purchasing capacity by individuals continued. This condition necessitated a greater genuine and basic interest in land for what it will yield and a lessening speculative interest in real estate developments. Vertical expansion of cities will slow up, slums disappear and population numbers become static if not declining. More homes will result in the fringes of cities.

As to water supply, more and better quality of water will be demanded and extensive Metropolitan Systems will have to be established to supply homes in suburban communities. Water softening will be more in demand and more water will be used in gardening and grounds beautification. Material prosperity will take its great toll and too, the industrial city had not proved its right to a place. Artisanship had been killed in the machine age which must be made safe for the future age.

For "the city that is to be" Mr. Dykstra picturized one with enough but not too much industry—one of homes affording also an opportunity to mix recreation with work in a proper ratio. In the city of the future the engineer would play an important part in its planning on a comprehensive basis.

The Income Tax Question

For the Committee on Income Tax Payment by Water Works Employees, W. W. Brush, as Chairman, reported that the U. S. Internal Revenue Department continues to hold that incomes of employees of Municipal Water Departments are subject to income taxation as is true of privately owned utility employees. To be tested this ruling must be acted upon by the Supreme Court during which time a few municipal water works employees have paid income tax while others have been required to pay 6 per cent interest on the tax held to be in arrears. There appears to be a willingness to consider 50 per cent of the salaries paid operating personnel as chargeable to fire protection costs and therefore non-taxable, the other 50 per cent being held to be paid for utility services and taxable. Mr. Brush reported that New York City was going to the cost of making his case a test case in which 25 per cent was the accepted distribution of salaries to utility function of the Water Department employee.

In reply to questions he said that if a water works employee had not been called upon to pay the tax now 2 years past due there could be no opening of the returns of greater age. However, since 1933 the period of 3 years held and therefore through 1936 the tax on 1933 income could be held to be in arrears. If called upon to pay tax or interest, Mr. Brush suggested that a formal protest be filed with each payment.

T. A. LEISEN of Omaha said that so long as the income of a municipal utility (for example the Metropolitan Utilities District of Omaha) was not held taxable he could not understand the propriety of taxing the employee thereof.

L. H. ENSLOW thought that perhaps a good and safe investment might be available to water works employees who by paying the tax under protest would receive the refunded tax, with interest at 6 per cent on the payment, should the decision be in favor of the water works employee. If the reverse, then the employee who had not paid anything would have to dig down and pay the back tax for possibly three years and the accumulated 6 per cent interest in addition. Such investment possibilities seemed worth looking into provided the tax payment would be accepted by the Collector pending decision of the courts. All reclaimed overpayment of income taxes was being returned by the Revenue Collector's office with interest payments at the rate of 6 per cent, regardless of to whom the adjustment was returned or just why it was returned. In any event the idea was worthy of investigation.

NOTE: In the next issue will appear a digest of technical papers, Committee reports and discussion, for which space in this issue is not available.—Editor.)

On the Boat Trip

From left: 1. C. N. Harrub (Nashville, Tenn.), J. W. McAmis (Greeneville, Tenn). 2. W. M. Wallace (Cleveland), Sam B. Morris (Pasadena, Calif.). 3. B. S. Robinoff (Pittsburgh, Pa.), H. P. Boncher (Bradford, Pa.). 4. Homer Denny, Supt., Water Works at Norwood, Ohio, making the steam calliope on the "Island Queen" talk.

ELECTRON-SHELLS, ELECTRON-ATMOSPHERES AND WEATHER

By HALBERT P. GILLETTE

UNTIL a wireless signal was sent across the Atlantic by Marconi, no physicist had dreamed that the earth is encased in one or more electron-shells. In fact Marconi's announcement of his achievement in 1901 was received with genial skepticism by physicists. Lord Rayleigh promptly remarked that wireless waves would be reflected from the earth's surface and therefore could not travel around the curved surface of the earth. But Marconi had accomplished what a "better informed" scientist like Rayleigh would never have attempted. Here is one of many instances where much learning is a dangerous thing, and a little learning is a blessing.

The history of science contains not a few similar instances. "Wise" astronomers never looked for a sun-spot cycle, but an "ignorant" German apothecary did—and after many years of observation found the now celebrated Schwabe sun-spot cycle. "Wise" geologists never dreamed of an Ice Age, but a biologist, ignorant of geology, did; and thus Agassiz revolutionized geology. "Wise" mathematicians never tried to improve on the old fashioned multiplication table, but a man very slightly trained in mathematics, undertook the task and succeeded. He was John Napier, inventor of logarithms. Incidentally his success furnished something beside evidence that it sometimes pays to be not too wise, I refer to the significant fact that he was sixty-four years old when "In 1614 appeared Napier's work which in the history of British science can be placed second only to Newton's Principia."

I could give, by the hour, similar successful instances of "fools rushing in where" so-called wise-men "feared to tread." There is a sort of "wisdom" that can see no hope for any new theory either if it conflicts in the least with any old theory or if it can not meet at once every objection raised against it. Curiously enough that type of "wisdom" is often found in men that are really wise and original, as exemplified in Lord Rayleigh.

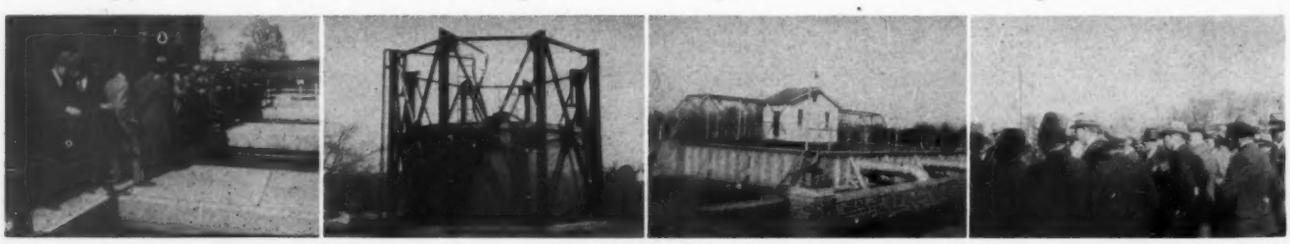
Lord Rayleigh's scientific doubts were finally cleared away when Professors Kennelly and Heaviside independently suggested the existence of an ionosphere that would reflect radio waves back to the earth, and by a series of reflections or echoes enable such a wave to travel around the earth. Their suggestion was soon followed up by scientific observations that demonstrated the existence of "the Kennelly-Heaviside layer" at an elevation of about 62 miles; nor was it many years before another similar shell of ions was discovered by Appleton at a height of about 125 miles. Stoermer's radio echo observations indicate, I think the existence of several more terrestrial electron-shells of vast diameter.

I prefer to call these ionized layers electron-shells than to use the more common term ionosphere, for the evidence is very strong that they owe their properties mainly to electrons (negative charges) and not to protons (positive charges). The earth is constantly emitting electrons which would neutralize most of the protons in any ionosphere, leaving a great preponderance of electrons. The fact of a terrestrial emission of electrons has long been established, but it has been a puzzling fact. A common explanation has been that electrons emitted by the sun enter the earth near its magnetic poles, flowing in the well known spirals around magnetic lines of force. Then the electrons that thus enter near the poles are supposed to escape again in lower latitudes. This hypothesis is very plausible, but it only removes the puzzle from the earth to the sun. What causes a preponderance of electrons to escape from the sun? Dr. Swan has suggested that both in the earth and sun there is going on a destruction of more protons than electrons as a result of their mutual electric activity. This, too, is plausible. But it seems to me even more plausible that under great gravitative pressure both protons and electrons are being destroyed, and that the destruction of protons is greater than that of electrons. The less density of the electron would cause fewer electrons than protons to exist near the center of a heavenly body, and thus lead to disintegration of more protons than electrons.

Incidentally this hypothesis also explains why the luminosity of a star increases with its mass, which Swan's hypothesis does not explain. Whenever a scientific hypothesis explains phenomena that it was not originally designed to explain, the probability of its being true is increased.

The earth is emitting electrons, whatever the cause. Presumably other heavenly bodies are likewise emitting electrons. Therefore every planet and every star is probably the core of an atmosphere of electrons whose diameter is infinitely great. The mean density of such an electron-atmosphere must vary inversely as the square of the distance from the core. At intervals in such an electron-atmosphere there are probably rotating electron-shells, like the Kennelly-Heaviside shell and the Appleton shell. Since such electron-shells are rotating they are magnets, and their magnetic strength increases with the tangential velocity of rotation and with the number of

Snapped at the Lancaster Meeting of the Pennsylvania Water Works Operators' Assn.



From left: (1) *Inspection of Lancaster's New Sewage Treatment Works;* (2) *One of the Many Novel Features, Gas Holder at Center Top of Sludge Digestion Tanks;* (3) *The First Dorr Clarifier to Be Installed at a Water-Treatment Plant Is Still in Service at Lancaster;* (4) *Leon Duckworth Telling a Group About the New Filtration Plant of which Lancaster May Be Proud.*

electrons in the shell. This much is derivable from well known physical laws. We now come to an equally certain but surprising conclusion if there are such things as electron-atmospheres of vast diameter, namely, that:

The magnetic force of every electron-shell diminishes at a far less rate than does the force of gravitation, for it induces whirls of electrons in the electron-atmosphere.

In short the electron-atmospheres that permeate all space serve just as iron serves in concentrating magnetic lines of force. Let an iron filing be placed six inches away from the pole of a small bar magnet, and it will not move toward the magnet. But strew many iron filings between it and the magnet, and the lines of magnetic force will become so concentrated that the distant filing will be moved toward the magnet. In the case of the iron, certain of its orbital electrons become oriented by the magnetic force, and magnetism is said to be induced in the iron. Similarly magnetic polarity is induced in electron-atmospheres. The spiral path of moving electrons around magnetic lines of force is a well known laboratory phenomenon. The same thing must occur in electron-atmospheres.

It follows from this theory that if a terrestrial electron-shell gyrates, its axis points most directly sunward at intervals, and when thus pointing it induces a maximum of magnetism in the vast electron-atmosphere that encases the sun. This results in pulling the terrestrial electron-shell sunward to a maximum extent. The resulting displacement of the shell, causes electron currents both in the earth's atmosphere and in the earth itself. Electrons moving in the atmosphere must cause air currents, and may, indeed, be responsible for much of the circulation now attributed to differences in temperature.

The gyration of a terrestrial electron-shell causes its periodic displacement by interaction with the earth's magnetic field. This may account for many weather cycles, for there are many electron-shells.

There has been a peculiar indifference among meteorologists as to any electric or magnetic theory of weather changes, in spite of the fact that the greatest of all electrical researches long ago advanced a magnetic theory of air currents. Perhaps this indifference is mainly due to not having read Faraday's theory, which briefly is as follows:

"It becomes a fair question of principle to inquire how far masses of air may be moved by the power of the magnetic force which pervades them. When two bulbs of oxygen in different states of density are subjected to a powerful magnet with an intense field of force, the mechanical displacement of one by the other is most striking. * * * And when so little as one-third of a cubic inch of oxygen can exert a force equal to the tenth of a grain, subject to the action of our powerful magnet, we may well conceive that the enormous sum of oxygen present in only a few miles of heated or cooled atmosphere, can compensate for the great difference of magnetic force, and so, by change of place, cause currents of winds having their origin in magnetic power."—Faraday's "Experimental Researches in Electricity," Vol. III, p. 265.

Faraday is here speaking of the effect of terrestrial magnetism upon oxygen, the most magnetic of gases, when it differs in density in different regions. The electron was not discovered until some 40 years after he advanced (in 1850) his magnetic theory of air currents We may be sure that he would not have been slow to see that air currents of much greater force can be caused by electrons in motion than by the action of terrestrial magnetism upon oxygen. The point that I am trying to make is that there is no well founded objection to a magnetic theory of weather changes when so great a researcher as Faraday espoused such a theory. I grant that existing physical theories have seemed to make it improbable that the Kennelly-Heaviside shell could be periodically displaced to any considerable extent either by its own magnetic action upon the sun or by the sun's magnetic action upon it. But let it be remembered that that very shell was not even suspected 35 years ago, and it will be admitted that hitherto unsuspected atmospheres of electrons may exist. If they exist, as above indicated, then the supposed impossibility of weather cycles due to magnetic action ceases to be an impossibility.

What is sorely needed is more of Faraday's optimism and less of the prevalent skepticism about magnetic force as a cause of air currents. Skepticism never has led to any important discovery, but it has often retarded the advance of science for generations.

Subsequent articles will discuss the reason why electron-shells exist, why terrestrial electron-shells gyrate and cause weather cycles, why cyclones and anticyclones are caused by terrestrial magnetic forces, why such whirls persist and travel, why the stratosphere is probably an electron-shell, how semi-diurnal barometric lows are caused by a distortion of electron-shells, why clouds often exist in distinct strata, and other phenomena that are well explained by the electron-shell theory.

▼

J. F. Laboon Made Director of Relief

John F. Laboon has recently withdrawn from his firm, Chester, Laboon, Campbell, Davis and Bankson, Consulting Engineers, Pittsburgh, Pa., in order to accept an appointment as Director of the Works Division of Allegheny County, Pa., for the State Emergency Relief Board. In his new work he will have charge of putting unemployed to work on useful projects. Mr. Laboon is on indefinite furlough and expects to resume his connection with his firm after the work is completed.

Snapped at the Lancaster Meeting of the Pennsylvania Water Works Operators' Assn.

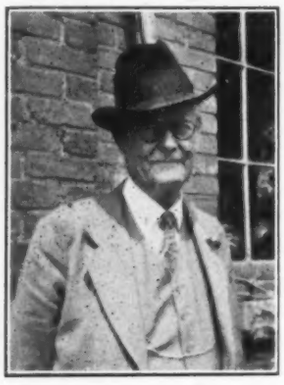
From left: (1) *Mike Glace, Association Secretary and "Wheel-Horse," with Jim Malone (Host), Lancaster's Able Superintendent of Water and Sewage;* (2 and 3) *Groups of "Inspectors" at the Plants. From the Rear Is Allentown's Harry Krum, Chairman of Eastern Division, and Peeping Around the Corner is Darling's Shorty Dawson;* (4) *John Campbell and J. H. Miller of J. N. Chester, Engineers, Designers of the New Water and Sewage Works Plants.*

FILTERED WATER SERVED AT WELL-WATER TEMPERATURE

By WM. M. RAPP

Superintendent of Distribution
Atlanta Water Department, Atlanta, Ga.

A COOL drink of pure water on a hot day is very refreshing but few municipalities or private concerns are equipped nor can they afford to supply artificially cooled water to their drinking fountains in parks, on golf links and elsewhere.



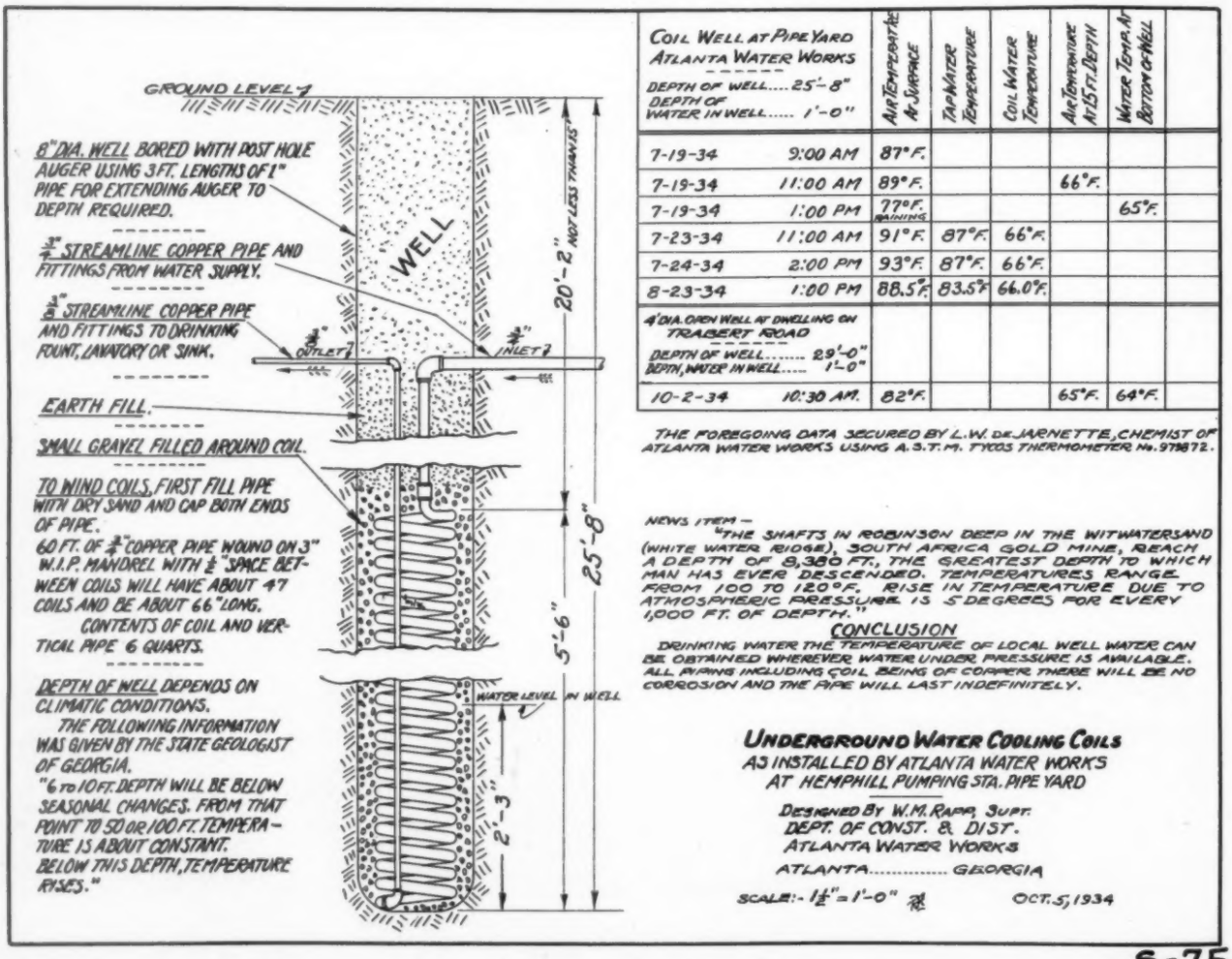
Wm. M. Rapp

Fortunately, the problem of supplying cool refreshing water can be easily and permanently solved with very little expense. At the same time, there will be available a reasonable rate of yield from the constant supply of wholesome and safe drinking water from the city mains at the healthful and palatable temperature of natural well and spring waters.

The Atlanta Water Department has had two ground water coolers, similar to the one shown in the accompanying illustration, in service for the past four years and these proved to be so satisfactory that a third was installed in the summer of 1934. From the functioning of this last installation the data shown on the sketch was obtained.

On July 24, 1934, the air temperature was 93 degrees F. and the tap water temperature from the city mains was 87 degrees F., whereas the temperature of the water from the depth-cooler was 66 degrees F. A check up against water temperatures in wells in the vicinity showed that the tap water, after passing the copper coils of the earth cooler, was the same temperature as waters in the wells observed.

The accompanying sketch tells its own story of how the coolers are constructed and the results obtained.


GROUND LEVEL
8" DIA. WELL BORED WITH POST HOLE AUGER USING 3 FT. LENGTHS OF 1" PIPE FOR EXTENDING AUGER TO DEPTH REQUIRED.
¾" STREAMLINE COPPER PIPE AND FITTINGS FROM WATER SUPPLY.
¾" STREAMLINE COPPER PIPE AND FITTINGS TO DRINKING FOUNT, LAVATORY OR SINK.
EARTH FILL.
SMALL GRAVEL FILLED AROUND COIL.
TO WIND COILS, FIRST FILL PIPE WITH DRY SAND AND CAP BOTH ENDS OF PIPE.
60 FT. OF ¾" COPPER PIPE WOUND ON 3" W.I.P. MANDREL WITH ½" SPACE BETWEEN COILS WILL HAVE ABOUT 47 COILS AND BE ABOUT 66" LONG.
CONTENTS OF COIL AND VERTICAL PIPE 6 QUARTS.
DEPTH OF WELL DEPENDS ON CLIMATIC CONDITIONS.
THE FOLLOWING INFORMATION WAS GIVEN BY THE STATE GEOLOGIST OF GEORGIA.
"6 TO 10 FT. DEPTH WILL BE BELOW SEASONAL CHANGES. FROM THAT POINT TO 50 OR 100 FT. TEMPERATURE IS ABOUT CONSTANT. BELOW THIS DEPTH, TEMPERATURE RISES."
WELL
OUTLET
INLET
20'-2" NOT LESS THAN 15'
25'-8"
5'-6"
WATER LEVEL IN WELL
2'-3"

COIL WELL AT PIPE YARD ATLANTA WATER WORKS DEPTH OF WELL..... 25'-8" DEPTH OF WATER IN WELL..... 1'-0"		AIR TEMPERATURE AT SURFACE	TAP WATER TEMPERATURE	COIL WATER TEMPERATURE	AIR TEMPERATURE AT 15 FT. DEPTH	WATER TEMP. AT BOTTOM OF WELL	
7-19-34	9:00 AM	87°F.					
7-19-34	11:00 AM	89°F.			66°F.		
7-19-34	1:00 PM	77°F. RAINING				65°F.	
7-23-34	11:00 AM	91°F.	87°F.	66°F.			
7-24-34	2:00 PM	93°F.	87°F.	66°F.			
8-23-34	1:00 PM	88.5°F.	83.5°F.	66.0°F.			
4' DIA. OPEN WELL AT DWELLING ON TRABERT ROAD DEPTH OF WELL..... 29'-0" DEPTH, WATER IN WELL..... 1'-0"							
10-2-34	10:30 AM.	82°F.			65°F.	64°F.	

THE FOREGOING DATA SECURED BY L.W. DE JARNETTE, CHEMIST OF ATLANTA WATER WORKS USING A.S.T.M. TYCOS THERMOMETER No. 979872.

NEWS ITEM—
"THE SHAFTS IN ROBINSON DEEP IN THE WITWATERSAND (WHITE WATER RIDGE), SOUTH AFRICA GOLD MINE, REACH A DEPTH OF 8,380 FT., THE GREATEST DEPTH TO WHICH MAN HAS EVER DESCENDED. TEMPERATURES RANGE FROM 100 TO 120°F. RISE IN TEMPERATURE DUE TO ATMOSPHERIC PRESSURE IS 5 DEGREES FOR EVERY 1,000 FT. OF DEPTH."

CONCLUSION

DRINKING WATER THE TEMPERATURE OF LOCAL WELL WATER CAN BE OBTAINED WHEREVER WATER UNDER PRESSURE IS AVAILABLE. ALL PIPING INCLUDING COIL BEING OF COPPER, THERE WILL BE NO CORROSION AND THE PIPE WILL LAST INDEFINITELY.

UNDERGROUND WATER COOLING COILS
AS INSTALLED BY ATLANTA WATER WORKS
AT HEMPHILL PUMPING STA. PIPE YARD

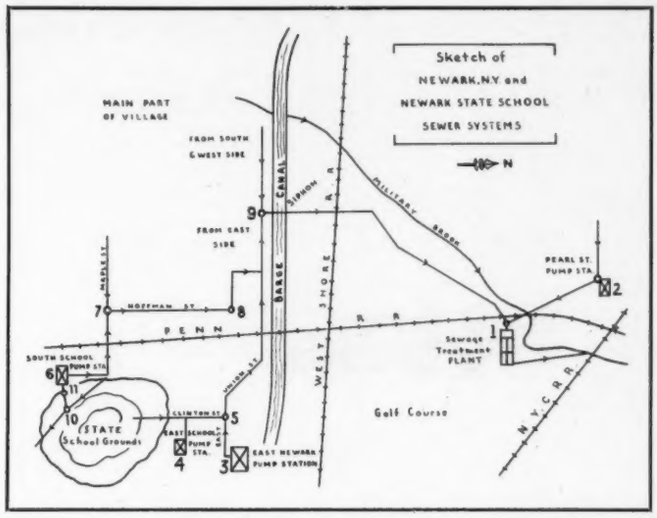
DESIGNED BY W.M. RAPP, SUPT.
DEPT. OF CONST. & DIST.
ATLANTA WATER WORKS
ATLANTA..... GEORGIA

SCALE:- 1½" = 1'-0" OCT. 5, 1934

S-75

Underground Water Cooling Scheme of Atlanta Water Department

Sketch of Newark, N. Y., and Newark State School Sewer Systems



SULPHATES TO SULPHIDES

By CHARLES C. AGAR*
Albany, N. Y.

SULPHATES in sewage are not objectionable as such but when they break down to form sulphides they may be the source of one of the most serious problems that a superintendent of sewers or a plant operator has to face. Hydrogen sulphide is a gas which not only has an offensive migrating odor but also is corrosive and is the cause of much disintegration of sewers and structures at treatment plants. Relatively low concentrations of this gas are sufficient to create a health hazard because of its extreme toxicity.

Sulphur is always present in some form in sewage. In fresh sewage it occurs usually in combined form as inorganic sulphate or in some organic sulphur compounds. As pointed out by Mahlie[1] these forms may be perfectly inodorous but under certain conditions frequently break down to yield the obnoxious hydrogen sulphide.

Sulphur in sewage may originate from three sources as listed by Buswell and Elder[2]: (1) the sulphur present in the water supply, (2) that from industrial wastes and (3) that from excreta. They conclude that, in the absence of industrial wastes, the greater part of the sulphur originates from the sulphates of the water supply.

The results of work carried out recently by Baumgartner[3] show that fresh sewage does not form hydrogen sulphide readily for several days but when seeded with stale solids decomposition proceeds at a rapid rate. The time required is also influenced by the temperature of the sewage so that hydrogen sulphide may be produced very quickly in a seeded warm sewage.

Experiences at Newark, N. Y.

The above facts are particularly significant in view of the results of investigations carried out during 1933 at Newark, N. Y., to determine the source of hydrogen sulphide occasionally present in objectionable amounts in the raw sewage reaching the treatment plant. Odors were noticed in the vicinity of the screen and grit chambers, especially in the early morning and evening hours.

Newark is an incorporated village in Wayne County about 30 miles east of Rochester. The village has a population of about 8,000, of which 1,800 are located at the Newark State School. The village is largely residential, although there are several factories and industries including a creamery, milling establishment, cannery, paper box factory and a few smaller miscellaneous establishments.

The village water supply is obtained from Case Creek and is treated with alum, filtered and chlorinated before distribution. The water has a normal hardness of 250 to 300 p.p.m. and a sulphate content of 100 to 150 p.p.m.

The sewer system consists of about 16 miles of sewers ranging in size from 6 to 18 inches, discharging by gravity to a treatment plant in the northeasterly section of the village. This plant is of the activated sludge type, consisting in general of a screen chamber, grit chambers, primary settling tank, aeration tanks, final settling tanks, separate sludge digestion tanks and glass covered sludge drying beds. (A complete description of the plant was given by Holmes in WATER WORKS AND SEWERAGE 80, 159 (May, 1933). The plant effluent is discharged into Military Brook, a small tributary of Canargua Creek.

The New York State Barge Canal passes through the central part of the village and necessitates a siphon crossing (9) under the canal. At this point the sewage from the southerly and westerly portions of the village enters the siphon through one sewer and the sewage from the easterly section through another sewer. The siphon chamber, therefore, forms a junction point for all sewage south of the canal. There are two pumping stations in the village system serving small areas which cannot be sewered by gravity. These stations are the Pearl Street Station (2) in the northerly part of the village and the East Newark station (3) in the easterly part of the village.

The Newark State School is located in the southeasterly part of the village on an elevation south of the Barge Canal. The institution serves as a school for mentally defective men, women and children.

The water supply for the power house and for use in the hot water system is obtained from the Barge Canal, treated with alum, settled and softened by Zeolite filters before use. Water for all other purposes is obtained from three springs about two miles south of the institution.

*Sanitary Engr.—N. Y. State Dept. of Health.

NEWARK AND NEWARK STATE SCHOOL SEWER SYSTEM INVESTIGATION
NOVEMBER 14–15, 1933

Date	Time	Location	Sample From	Temp. °F.	H_2S (ppm)	Remarks
Nov. 14	9:30 A. M.	1	Raw sewage entering village plant	62	1.0±	Sample turbid—no H_2S odor
	10:30 A. M.	2	Sewage in pump well (Pearl St.)	54	0	
	10:55 A. M.	3	Sewage in pump well (East Newark)	76	..	Too yellow to test—Apple cider odor
	11:30 A. M.	4	Sewage in pump well (East School)	64	14.0	Very strong H_2S odor
	12:00 M.	5	Institution sewer (East Union St.)	66	4.0	H_2S distinct—East school pump operating
	12:45 P. M.	1	Raw sewage entering village plant	64	1.0±	No H_2S odor detectable
	1:25 P. M.	6	Sewage entering pump well (South School)	72	1.0—	No H_2S odor detectable in sample
	1:45 P. M.	7	Institution sewer (Maple and Hoffman St.)	66	2.0+	South school pump operating
	2:15 P. M.	8	Village sewer (Hoffman St.)	66	3.0	Slight H_2S odor
	2:30 P. M.	9	East side sewer at siphon	75	2.0+	
	2:40 P. M.	9	West side sewer at siphon	60	0	Medicinal odor
	3:15 P. M.	10	Sewer from east line at school	76	0	
	3:25 P. M.	10	Sewer from west line at school	68	0	
	3:30 P. M.	11	Sewer to pump station (South School)	68	.5	No H_2S odor detectable
	3:45 P. M.	6	Sewage entering pump well (South School)	68	1.0	
	3:50 P. M.	6	Sewage in pump well (South School)	74	10–12	Very decided H_2S odor
Nov. 15	9:25 A. M.	6	Sewage entering pump well (South School)	..	0	
	9:30 A. M.	6	Sewage in pump well (South School)	..	3.5	Odor distinct H_2S
	9:45 A. M.	5	Institution sewer (East Union St.)	..	.5—	No H_2S odor

The sewage from the main buildings discharges by gravity into the village system at East Union Street (5). This sewer carries all the sewage from the women's quarters and the laundry of the institution. A small pumping station serving employes' houses discharges through a force main into the main gravity sewer from the institution on Clinton Street.

During 1931 and 1932 new buildings, including dormitories, dining room, kitchen, recreation hall and laboratory, were constructed on the slope to the south of the main buildings. This required the construction of additional sewers discharging to a pumping station (6) southwest of the institution. The sewage is pumped into a gravity sewer on Maple Street, entering the village system at Hoffman Street.

Hydrogen Sulphide Survey

Prior investigation of the village sewer system to locate sources of hydrogen sulphide was carried out during June, 1933, by W. M. Bingley, assistant sanitary engineer of the Chlorine Institute, and G. W. Holmes from the office of Glenn D. Holmes, consulting engineer for the village. The results of this investigation indicated that the source of the hydrogen sulphide reaching the village plant was in the sewer system serving the state institution.

In order to corroborate previous findings and to further locate the source of the hydrogen sulphide, two investigations were carried out by the writer in cooperation with the village and institution authorities and the consulting engineer. The first of these investigations was made to determine possible sources of hydrogen sulphide from wastes at the institution, including those from the laundry, hospital, laboratory, etc. There were no chemicals or wastes found which could account for the hydrogen sulphide in the sewer system, but it was found that the water supplies used at the institution contained abnormally high sulphate contents, particularly the cold water supply from the spring source which had a sulphate content of 491 p.p.m. at the time.

The second investigation involved tests for sulphides at various points in the village and institution sewer systems. This work was carried out in the field using a modification of the Salle and Reinke method* which employs an antimony potassium tartrate solution, made up with gelatin to prevent coagulation, sodium chloride and hydrochloric acid. The test is colorimetric and solutions of potassium dichromate were used for color standards.

The results of this work are given in the accompanying table. Although sulphides were found in the sewage entering the village plant, none could be detected in the village pumping stations or in lines which did not carry sewage from the state institution. It was noted that the highest concentrations of sulphides were found in the wet wells of the sewage pumping stations at the institution. A description of the pumping stations and their method of operation will aid in understanding the results obtained.

*The Salle–Reinke procedure is available upon request to The Chlorine Institute, 50 E. 41st St., New York City.

Source of the Trouble

The wet well at the East school pumping station consists of a converted cistern with a flat floor and having a capacity of about 12,000 gallons. This station serves buildings housing 15 to 20 employees of the institution. The well is 30x13 feet in plan and cannot be emptied by the vertical centrifugal pumps (150 g.p.m.) suspended in the tank because of loss of suction at about 1 foot depth. No water supply is available for flushing purposes. The well, therefore, acted as a large septic tank, having a detention period of two to six days, depending on the elevation maintained in the well.

The odor of hydrogen sulphide was very strong in this well and a sample showed 14 p.p.m. sulphides present. Corrosion of metal fixtures in the station further confirmed the presence of considerable hydrogen sulphide. The presence of such large amounts of sulphides in the wet well was without doubt due to the high sulphate content of the water supply, the long detention period and ideal seeding conditions from accumulated stale solids.

The wet well at the South school station (6) also has a flat bottom. The well is 17 by 13 feet in plan and has an effective depth of 8 feet. Two 350 g.p.m. vertical centrifugal pumps are provided in an adjacent dry well. The well has a capacity of some 13,000 gallons and the floats were set to pump down to a 2-foot depth.

Hydrogen sulphide odor was distinct to strong at the times of taking samples which showed the presence of from 3.5 to 12 p.p.m. in the sewage in the well. There is no water under pressure available for flushing purposes. Corrosion of the float controls had required the installation of new equipment a short time before the inspection.

There were about 330 persons contributing to this station. The wet well, therefore, provided a detention period of from 5 to 10 hours with a much longer period during the night hours.

The absence of appreciable sulphides in the incoming sewage and the presence of large amounts of sulphides in the wet well showed that the well was the point at which the sulphides were being developed. It was noted also that the temperature of the sewage in the system at this point was generally higher than in the village system.

The pumping stations in the village system, while having flat-bottomed wet wells are provided with water for

flushing purposes. These wells are flushed out almost daily and the automatic switches are adjusted so as to practically empty the well during each pumping period. The detention period in these wells is also relatively short, averaging two to four hours. There is, therefore, little opportunity for septic action to develop in these compartments.

It was concluded that the origin of sulphides in the sewage entering the treatment plant was in the pumping stations at the Newark State School. Conditions in these wet wells were favorable for the development of sulphides. The high sulphate content of the water supplies, the lack of flushing facilities, long detention periods in the wells, the flat bottoms of the wells with resulting accumulation of stale solids and relatively high temperatures all contributed to the rapid production of sulphides.

In order to correct these conditions, it is planned to install a sloping or hopper bottom in the wet well at the South school pumping station and provide a water supply for regular flushing at this station. It is also planned to abandon the East school pumping station and carry the sewage from this system into the village system by gravity. The village has also secured the use of a chlorinator so that prechlorination for odor control can be practiced.

It is expected that these changes in the systems, when completed, will eliminate the odorous hydrogen sulphide problem from the raw sewage at the treatment plant.

REFERENCES

[1]Sewage works Journal VI, 3 (May, 1934) 547.
[2]Ind. Eng. Chemistry 21, 560 (1929).
[3]Sewage Works Journal VI, 3 (May, 1934) 399.

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S. B. Morris to Head Stanford's C. E. Department

Samuel B. Morris, Manager and Chief Engineer of the Water Department of Pasadena, Calif., will resign in the fall of this year to take the chair of civil engineering in Leland Stanford University at Palo Alto, Calif.

S. B. Morris

With this change, Mr. Morris will have to his credit a highly successful professional career of 22 years with Pasadena's Water Department, leaving as a monument to his accomplishments the Pine Canyon dam which was built under his supervision, with several innovations in dam construction. In his honor the city changed its name to "The Morris Dam" and it was so dedicated by another famous engineer and an ex - president of the United States—Herbert Hoover.

Mr. Morris has long been a leader in water supply engineering on the west coast and is prominent in the American Water Works Association which in 1933 bestowed upon him the John M. Diven Medal for "Outstanding Services for the good of the Association."

M. S. Jones, now Assistant Chief Engineer of the Pasadena Water Department, will succeed Mr. Morris at Pasadena.

Association Meetings Scheduled

May 16-17—**Maryland-Delaware Water and Sewerage Association.** Annapolis, Md. Sec'y-Treas., A. W. Blohm, State Department of Health, Baltimore, Md.

May 16—**New England Water Works Association.** (Spring meeting.) Mohican Hotel, New London, Conn. Sec'y, Frank J. Gifford, 613 Statler Building, Boston, Mass.

May 16-18—**Pacific Northwest Section A. W. W. A.** Lewiston, Idaho. Sec'y, E. C. Willard, 720 Corbett Bldg., Portland, Ore.

May 17-18—**Illinois Association Sanitary Districts,** Urbana, Ill. Sec'y-Treas., G. H. Radebaugh, Urbana, Ill.

May 24-25—**New York State Sewage Works Association.** Poughkeepsie, N. Y. Sec'y, A. S. Bedell, State Department of Health, Albany, N. Y.

June 24-26—**Pennsylvania Sewage Works Association.** State College, Pa. Sec'y, L. D. Matter, State Department of Health, Wilkes-Barre, Pa.

June 26-28—**Pennsylvania Water Works Operators Association.** State College, Pa. Sec'y, I. M. Glace, State Department of Health, Harrisburgh, Pa.

July 3-5—**American Society Civil Engineers.** (Annual Convention.) Sec'y, Geo. T. Seabury, 33 West 39th Street, New York City.

Aug. 22-23—**Central States Section A. W. W. A.** (Annual meeting.) Pittsburgh, Pa. Fort Pitt Hotel, Pittsburgh, Pa. Sec'y, H. Lloyd Nelson, U. S. Pipe and Foundry Co., Koppers Bldg., Pittsburgh, Pa.

Oct. (3rd week)—**Pennsylvania Water Works Association.** (40th annual meeting.) Haddon Hall, Atlantic City, N. J. Sec'y, H. F. Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Oct. 7-10—**American Public Health Association.** (64th annual meeting.) Hotel Schroeder, Milwaukee, Wis. Asst. Sec'y, W. R. Walsh, care A. P. H. A. Rockefeller Center, New York City.

Oct. 14-17—**Southwest Section A. W. W. A.*** Houston, Texas. Sec'y, Lewis A. Quigley, Supt. Water Works, Fort Worth, Texas.
(*Former Southwest Water Works Assn.)

Oct. 14-15—**American Society Municipal Engineers and International Association Public Works Officials.** Netherland Plaza Hotel, Cincinnati, Ohio. Executive-Director, D. C. Stone, 850 East 58th Street, Chicago, Ill.

Oct. 18-19—**Minnesota Section, A. W. W. A.** (Hotel to be selected.) St. Paul, Minn. Sec'y-Treas., R. M. Finch, Wallace and Tiernan Co., 416 Flour Exchange Bldg., Minneapolis, Minn.

Oct. 23-26—**California Section A. W. W. A.** San Diego, Calif. Sec'y, J. E. Phillips, Department of Water and Power, Los Angeles, Calif.

Nov. 6-8—**Missouri Valley Section, A. W. W. A.** Fort Des Moines, Ia. Sec'y-Treas., Earl L. Waterman, Prof. Sanitary Engineering, University of Iowa, Iowa City.

Nov. 4-6—**North Carolina Section A. W. W. A.** (Annual Convention.) Sec'y, M. F. Trice, State Board of Health, Raleigh, N. C.

Meeting of Florida Section A. W. W. A., Palm Beach, Fla., March 27-28, 1935

USE OF INHIBITORS IN CLEANING METALLIC PIPE

By ALLEN ABRAMS* and C. L. WAGNER*
Rothschild, Wis.

Allen Abrams

WATER pipes in certain sections of the country are likely to become clogged by corrosion or deposits from the water. In many cases this has required replacement of the pipes, a procedure which is often costly due to the necessity of tearing out walls and floors. As a result there have been attempts to clean pipes by the use of muriatic or other acids with the intent to leave the acid in just long enough to remove the scale and yet not long enough to attack the pipe itself. This, however, is a questionable expedient and may be more expensive than the replacement of the pipes.

During the last decade considerable interest has been shown in the use of inhibitors in pipe cleaning operations involving acid treatment. These are usually nitrogenous materials such as aniline or pyridine; and, even glue and flour have been used. When small quantities of such substances are added to an acid solution the resultant mixture will attack rust or scale but will have practically no effect on the pure metal itself. Wide use has therefore been made of this principle in the acid process of "pickling" metals to effectively remove scale while rendering the loss of metal underneath almost negligible.

An example is also given of the use of this principle in cleaning the pipes of a thirty-five story office building located in downtown New York.[1]

Many of the pipes were concealed behind expensive marble walls and it was estimated that it would cost between $100,000 and $300,000 to replace this piping, not to mention the serious inconvenience to tenants. By the use of an acid-inhibitor combination the whole cleaning operation was carried out on Saturday afternoon without inconvenience to the tenants. The pipes were returned to practically their normal condition of carrying capacities and the cost of the operation was but nominal.

These materials attracted our attention in 1927 and we made initial tests to determine how effectively inhibitors would reduce the action of acid on the metal. In parallel tests on galvanized iron pipes 16 per cent muriatic acid was used alone, to compare with the same acid containing 3 per cent of an inhibitor. Equal lengths of pipe were allowed to stand in each solution for six hours. At the end of that time the pipe in muriatic acid had lost 50 per cent of its weight while that in the inhibited acid had lost but 0.2 per cent of its weight. We were then satisfied that the inhibitors would effectively prevent destruction of the pipes by such acid when submerged for a relatively short period.

Not long afterwards two lengths of pipe, leading from the basement of our main office to the second floor became filled with rust and other deposit, completely stopping the passage of steam. It would have been relatively expensive to replace this piping and we therefore opened the two lengths at the top and cleaned them by pouring in inhibited acid, allowing it to work its way through. One overnight treatment, followed by a thorough flushing was sufficient to clean these pipes and no further trouble was encountered.

Early this year the Marathon County Board decided that it would necessary to tear out and replace all the water piping in the Mount View Sanatorium due to the fact that it was so stopped up that it was impossible to get an adequate water supply through the system. When the matter was brought to our attention we suggested that an attempt be made to clean several lengths of this pipe and a decision could then be made as to the further course to be pursued.

Twenty-five gallons of 14 per cent muriatic acid were treated with 3 per cent, by volume, of inhibitor. The treated acid was placed in a barrel to which was connected the suction of a small rotary pump. The acid was then forced upward from the basement to the second floor through a length of one inch pipe, thence through a cross-over and down through another length of pipe to the basement. The returning acid passed through a fine screen to remove any dislodged particles and thence to the solution barrel.

At the beginning of the test a considerable amount of solid material was dislodged from the pipes and it was almost impossible to force the acid through. The pipes were then opened on the second floor, the acid mixture was poured in and allowed to flow by gravity until the pipes were filled. The bottom openings were plugged, the acid allowed to stand for eight hours and the acid withdrawn and the pipes thoroughly flushed. Examination indicated that the scale had been practically completely removed. During the course of the treatment an impeller of the bronze rotary pump broke and thereafter we employed a force pump.

In order to determine how effectively the cleaning was being done, three 6-inch lengths were cut from a 1-inch pipe which was so clogged with rust and dirt that it was barely possible to get a pencil into the opening. One of these pipes was retained without treatment and the other two were connected in the circuit through which the acid was being pumped. At the end of about two hours one length of pipe was removed and found to be almost completely clean except for small patches of rust on the walls. After ten hours the other length of pipe removed for examination proved to be entirely free of rust and scale and there was no apparent action on the metal itself.

In the cleaning operation approximately 2,800 feet of pipe were treated, ranging from ½ inch to 4 inches in diameter. Estimates by George Baumgardt, who was in charge of the plumbing work, showed that the total labor costs were $870, while the cost of acid and inhibitor was approximately $20—a total of $890. Mr. Baumgardt estimated that the cost of replacing the piping would have been:

Galvanized pipe fittings and valves.....	$1,000
Labor for installation	5,000
Plaster, concrete floor and repainting....	2,500
Total	$8,500

Acknowledgment.—This paper was presented before the Wisconsin Section of the A. W. W. A. at Wausau.

*Department of Research and Development, Marathon Paper Mills Co., for which the senior author is Technical Director. Mr. Wagner is chemist.

[1] "Removing Rust from a System with Piping Acid," F. N. Speller, E. L. Chappell and R. P. Russell—Chem. and Met. Engineering, July, 1927.

RESULTS FROM ACTIVATED CARBON APPLIED TO A RESERVOIR

By MARSHALL S. WELLINGTON*
New Haven Water Co., New Haven, Conn.

THE Beaver Brook Reservoir of the New Haven Water Co. supplies the town of Milford, Conn. This reservoir has a capacity of 15 million gallons and a surface area of eleven and a half acres. The largest part of it is shallow, not having more than ten feet of water in it. The pumpage from this body of water averages 500,000 gals. a day. This amount is pumped in four to five hours and during remainder of day, no water being used, any excess runs over spillway.

In June of 1934 the water in the reservoir began to take on a greenish hue, which developed rapidly until the color of the water was forty. The green color at this time was very marked and had the look of pea soup. This color was more pronounced at the surface, where it was exposed to the sun, than lower down in the lake. The exact nature of this color and its cause was not completely determined. No appreciable taste or odor increase was noticed however.

Many methods of treatment were tried without success when in desperation "Nuchar," a powdered activated carbon, was resorted to. The thing feared in using this product was its lack of ability to settle out between pumpings and therefore that black water would be pumped to an already disgruntled public. After many experiments on the upper end of the lake a combination treatment was found which appeared satisfactory. This consisted of adding a sufficient amount of copper sulphate in the morning to give a dose of 0.5 p.p.m., which was followed, after the pumping was stopped in the afternoon, with an application of the "Nuchar" to give a dose of 1.5 p.p.m. This combination resulted in complete settling out of the carbon and copper before pumping was started the next morning. A reduction of color from forty to ten and a complete removal of the green color was obtained with this treatment.

In August a bad taste appeared in the water which can best be described as a musty marshy taste. The above treatment removed this taste, but not the cause. It came back in a few days. Being impractical to continually treat the lake in this manner to eliminate the taste the procedure was given up.

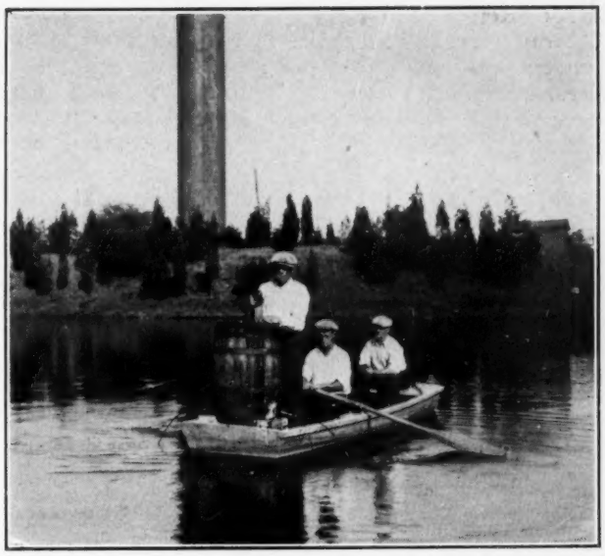
Further experiments with the supply, while not being used, were then tried with the following general results: (1) "Nuchar" without copper sulphate, very little settling in forty-eight hours. (2) Copper sulphate, 0.5 p.p.m., followed six hours later with 1.5 p.p.m. "Nuchar," settling in about twelve hours. (3) A two to one mixture of "Nuchar" and lime ("Nuchar" dose, 1.5 p.p.m.), settling in about three hours but with less absorption than the copper sulphate and "Nuchar."

The conclusions drawn from the experiments were: (1) "Nuchar" could be used successfully to eliminate color caused by algae. (2) Taste could be removed to some extent if a settling basin was at hand. (3) Copper sulphate followed by "Nuchar" gave the best results. (4) Amount of chemicals used must be determined by local conditions.

The copper sulphate was applied by dragging it in bags hung over the sides of a boat.

The "Nuchar" was applied in the manner described below, which proved very successful. (See illustration.)

*Superintendent of Chlorination and Treatment.



Applying Powdered Activated Carbon to Reservoir. A Crude But Effective Method. Note Streams Discharging in Wake of Oars.

Two one inch holes were bored on opposite sides of a fifty gallon barrel near the bottom. Glass tubing with an internal diameter of an ordinary pencil were inserted in rubber stoppers and the stoppers in their turn inserted in the holes in the barrel. Small stoppers were then inserted in the other ends of the tubing. The barrel was then placed on the stern of a boat. This allowed the outlet ends of the glass tubes to remain about four inches above the surface of the water. The man power was distributed as follows: One man to add the "Nuchar" to the barrel and keep it agitated. The second man to row the boat. The third man in the bow of the boat with a hydrant pump to keep a supply of water from the lake going into the barrel. The outlets on the glass tubes were made the proper size so that the man could keep the barrel full and yet not be overworked.

The "Nuchar" was mixed in a heavy soupy mixture in the barrel at the start and when the boat arrived at the place to start treatment the small stoppers were removed and the mixture allowed to run out. The man at the barrel added fresh "Nuchar" when the mixture became too thin, while the man with the pump kept the barrel full. The boat was rowed in a similar manner as when copper sulphate was applied. This method allowed the "Nuchar" to be added in a continuous manner in very fast time. A very noticeable feature of this method was the fact that the mixture flowing from the glass tubes penetrated under the surface of the water before it started to spread. After the addition of the "Nuchar" was completed there was very little floating on surface of water to give the appearance of a black scum.

It is well known that often copper-sulphate treatment where delayed too long is followed by algae decomposition, high bacterial multiplication and very foul tastes. In view of the results obtained in our experiments, the knowledge that powdered carbon can be applied to reservoirs following copper treatment may prove of value under such circumstances.

OUR DILEMMA

No Decision Reached in Plant Picture Contest

IN OUR April issue we printed pictures of a number of "Representative American Water Works Plants" which was a featured section in our Water Works Convention issue. When we proposed to submit these pictures to three architects who would serve as judges in the naming of three plants in their order of attractiveness architecturally, we bit off more than we could chew.

Editors of the three leading magazines in the architectural field were asked to make their selections. Each named three plants as requested but, as indicated in the following excerpts taken from opinions rendered, no one plant was named by any two of the judges for either the 1st, 2nd, or 3rd position. Nine different plants were named.

Opinions of Architectural Editors

By H. H. Saylor, Editor, *Architecture* (Chas. Scribner's Sons, Publishers).

"You have put up to me a difficult problem. However, my opinion, for what it is worth is founded on the contention that a building should convey as frankly as possible its real purpose in its architecture. In other words, there are some plants pictured which are pleasing architecturally, but these might be college libraries, suburban homes, or village town halls rather than water works plants.

"The three I select as looking to me like water plants and also being the most pleasing to the eye are:

"1. The filtration plant at Sacramento, Calif. (pp. 143, 146).

"2. The filtration plant at Ottawa, Canada (pp. 145, 146).

"3. The Springwells plant at Detroit, Mich. (p. 154)."

By Leonard Cox, Editor, *The Architectural Forum* (Time, Inc., Publishers).

"The task of attempting to select the three most attractive or unusual plants is an extremely difficult one due to the very different types of plants and the difference in location. However, here goes:

"1. The Contra Costa (Calif.) filtration plant (p. 148). Simple, modern design with distinct relationship to traditional architecture of the location.

"2. The Claremont (Calif.) pumping station (p. 144). Selected for the same reasons as was No. 1 and very difficult to choose between the two.

"3. The York (Pa.) filtration plant (p. 159). Traditional in design, appropriate to the locality and extremely well done."

By C. T. Larson, Technical Editor, *The Architectural Record* (F. W. Dodge Corp., Publishers).

"Architecturally, a water works plant should look like a water works plant and not like a college library, or a country mansion in Spanish or any other style. Good architecture is inseparable from good engineering. There is no reason why a water works plant should not be aesthetically pleasing in itself and in no need of ornament or artificial embellishments.

"What a water works plant should look like is a matter for specialists in this field of design to determine, and 20th century architecture should develop out of 20th century ideas of technology. The design problem in water works plants, as in no other type of structure, is one of continuous change, always directed to something better than exists.

"By my own logic, I should not judge, for I am not a specialist in this field of design. Selections made are based only on superficial appearances but which appear to be exemplary of advanced standards of design and, therefore, architecturally most interesting.

"1. The filtration plant at Burnt Mills, Md. (p. 149). No imitation of obsolete forms here. A solution of plant design and architecture *apparently* based on a rational study of modern operating efficiencies and modern fabrication technique. In addition, a good example of 20th Century design.

"2. The Activated Carbon 'Hydrodarco' Filters at Culver City, Calif. (p. 144). Honest and straightforward. The filters are no less architectural because unenclosed. As abstract forms, the tanks and pipes are aesthetically as attractive as a piece of sculpture by Noguchi or Brancusi. Why cover them up if unnecessary?

"3. The elevated tank at Aberdeen, S. D. (p. 163). Photographically excellent and probably equally so as a bit of technology. Why anything as fine and clean and graceful, as this tank is in appearance, should need comouflaging is beyond logical comprehension.

"Which of these structures is to be rated best is an empty question, for each appears to set a high standard in its own field. The three examples cited appear to serve their given requirements in a most direct and up-to-date fashion. On this basis they are, in my opinion, the most architecturally meritorious."

WE ASK YOUR ASSISTANCE

From the opinions of these editors of leading architectural magazines it is difficult to award prizes for the most architecturally pleasing plants. There seems to be no question as to which plant is most unique in its conception, engineering design and appearance and WATER WORKS AND SEWERAGE, therefore, selects the filtration plant at Burnt Mills, Md. (designed by Robert B. Morse of Hyattsville, Md.) as "America's Most Unique and Modern Filtration Plant." One editor has named it likewise the most architecturally pleasing, but we also have other editors' opinions to consider.

To help WATER WORKS AND SEWERAGE decide we need opinions from the field and we, therefore invite and urge our readers to assist by casting their votes in this matter. Kindly make three or more selections in order of preference and mail in promptly.—Editor.

EDITORIAL

Chlorinated Iron

ELSEWHERE in this issue there appears an article by I. R. Riker which warrants the attention of sewage work operators and sewerage authorities generally. The author, as engineer in charge of a sewage treatment works, relates experiences in odor control wherein pre-chlorination alone proved to possess shortcomings, whereas the use of the same quantity or less chlorine applied in an indirect method has proved most effective as an odor control measure. The results have been superior, the costs reduced, and the treatment made less likely to to give rise to complaint due to spotty efficiency, or difficulties resulting from over treatment.

The experiences of the author with pre-chlorination of sewages are not new. The strength of sewages and their complexity are not alone variable with changes of season and nature of the contributing population or industrial loading on sewer systems, but also a wide range in strength of sewage is to be expected during any 24-hour period. It is on this account that what may be a deficient daytime chlorine dosage, in an effort to destroy odors in stale sewages or to effect a suppression of septic action, becomes during certain late night or early morning hours an excessive dosage—one which may create a condition detrimental to the efficiency of the activated sludge process as pointed out by Rudolfs and Lacy in a series of articles now running in WATER WORKS AND SEWERAGE. It is frequently impractical to control odor production or sewage degradation by the preferred method of chlorinating the sewage in the sewers up the line while yet fresh or fairly so, such as has been effectively accomplished on the system of the Los Angeles County Sanitation Districts. Instead, it most frequently becomes necessary to do the complete job at or near the treatment works and frequently this is only after sulphides have been produced and the sewage solids have become so colloidized as to require heroic dosages of chlorine. The result is high cost of treatment and frequently the production of chlorinated degradation products which evolve those decidedly medicated odors noticed at the Princeton plant and elsewhere. The sewage works operator facing such a condition is confronted with the lay expression that a stench has been changed to a "smell." The operator may feel that he has done a fair job of odor control, but he is not satisfied alone with the cessation of complaint of distant neighbors as long as the public can still detect a "smell" when visiting the treatment works. To very nearby neighbors of the plant there still remains sufficient odor to warrant a complaint. Such circumstances causes the superintendent of the plant to go to extra trouble and expense in attempts to more effectively control the pre-chlorination, even to the extent of splitting the treatment (two point chlorination) or employing excessive chlorination which destroys all odor but is likely to produce troubles in biological secondary processes.

Mr. Riker, having experienced all of these conditions with the difficult sewage at Princeton, found no satisfactory and sure remedy until he struck upon the idea of trying the indirect method of chlorination which Messrs. Scott and Darcy put to effective use on the Oklahoma City sewers as a measure of chemical precipitation, but which proved even more highly successful as an economical, and efficient deodorizing and odor control scheme.

The method has much to commend it and bids fair to replace in part if not in whole the practice of pre-chlorinating sewages for odor control and elimination of sulphide-acid attack on masonry sewers. The conversion of scrap iron and tin cans from garbage incinerators to ferric or ferrous chloride with liquid chlorine is an intriguing procedure. The idea of disposing of tin cans by a process of "liquefaction" and discharge to sewers, with good effects, addition to being technically sound, possesses a bit of romance. While it is correct to say that 2 pounds of chlorine, as such, will destroy one pound of hydrogen sulphide in solution, this hardly ever becomes of practical attainment in sewage treatment. This, because the chlorine added to sewages can not be held away from the organic content and made to attack only the sulphide distributed throughout the sewage. Usually, therefore, 1 pound of sulphide in sewage will require three to four pounds of chlorine for its destruction in actual practice even though a quick effective chlorine distribution is had.

Now, by the chlorinated-iron route two pounds of chlorine will account for 1 pound of hydrogen sulphide removal. Why? Because the ferrous chloride, produced in dissolving iron in the easily controlled chlorinated-iron generator tower, attacks *only* the sulphides and has little or no affinity for the organic matters, ammonia, and the like. It becomes a matter of *indirect* chlorination in that the iron, in the form of soluble ferrous chloride, is capable of "fixing" the volatil sulphides in the form of non-volatil ferrous sulphide and the net result is an attainment of the theoretic ratio of chlorine required for destruction of hydrogen sulphide, as would be the case should the sulphide to be chlorinated be dissolved in water instead of an organic emulsion.

Looking at other advantages of chlorinated iron over direct chlorination, it is evident that in effect "residual chlorine" can be carried for many hours and for many miles down sewer if it be combined with "residual iron" which will persist in the presence of organic matter as "available iron" to care for later productions of volatil sulphide.

Aside from economy, efficiency and high practicability as an odor control process, to date unmatched, the moderate addition of iron serves to improve clarification, and digestion of sludge.. And, instead of proving hurtful in over-doses is an advantage to the secondary processes—especially those involving chemical or biological flocculation, or a combination thereof. From sprinkling filters it removes a portion of the loading, renders the humus more settleable; and, all in all, has many features which should bring to chlorinated-iron treatment a wide recognition and a likely universal application.

Likewise, in water treatment the chlorinated-iron process possesses proven merits as a coagulation measure which are also worthy of consideration.

Fuller & Eng.

NEW EQUIPMENT AND LITERATURE

Foxboro Universal Meter

Foxboro Company of Foxboro, Mass., have recently announced a Universal Meter and Recorder good for flow ranges of 1 to 10 and indicating and recording both pressure and flow or pressure, also temperature, rate of flow and total volume. An integ-

Foxboro Universal Meter

rator and integrator pen are supplied and charts are printed for ease of reading. A pressure compensator makes accurate readings possible—even when static pressures are widely varying.

For further details and more adequate information, write Foxboro Company, Foxboro, Mass.

▼

"Mainco" Distance Measure Wheel

The "MAINCO" Distance Measuring Wheel is a piece of novel and valuable equipment which makes it possible for one man alone to locate points, hidden valve boxes, manholes, mains and the like. It is especially valuable in the public utility field, including water works and sewerage.

An aluminum chassis carries a measur-

"Mainco" Distance Measuring Wheel

ing wheel, exactly 3 feet in circumference, which has a rubber tire to insure non-slip operation and accuracy. A counter, geared to the wheel, indicates feet and additional inches are indicated on the center disc. A spring operated plunger brake keeps the wheel locked but subject to release by handle trigger while in service. Weight is only 5½ pounds and handle is removable. No skill is required in its accurate usage.

For literature address the manufacturers the Maintenance Company, 453 W 42nd St., New York City.

▼

Copper Paint: Something New in Protection and Beauty

"Liquid Copper" is a new beautifying, protective and corrosion resistant paint. It was perfected by L. D. Pangborn, Chemical Engineer, who is production and plant manager of the recently formed National Copper Paint Company of Chicago.

The new paint, which consists of 98.3 per cent pure copper and contains no linseed or other oils commonly used in paints, has been the outcome of more than 8 years of experimentation and test, according to H. M. Rice, manager of Nichols Copper Company and President of National Copper Paint Company, 666 Lake Shore Drive, Chicago, Ill. For further information, request literature on this new product.

▼

Improved Emergency Light

A new 40-lb. 8,000 candle power Carbide Emergency Light, announced recently by the National Carbide Sales Corporation, has many applications in the water works and sewerage field.

The reflector is mounted on a universal swing joint, so that the light may be shifted to any angle and may be easily folded down for carrying by a convenient handle above the carbide hopper. The unit is three and one-half feet high when extended for use, and twenty-eight inches when folded.

Carbide Emergency Light

A 1¾-lb. charge of carbide placed in the hopper is sufficient for more than three hours' service. By throwing a lever, the carbide is released a few grains at a time into the water tank below, and the rate of feed of the dry carbide is regulated automatically by the gas pressure. The light may be shut off by throwing the lever back to locked position. The tank is made of 18-gauge sheet steel, hot-dipped in lead after the tank is welded. If the light is turned over it will go right on operating when again set upright.

For additional information, address National Carbide Sales Corp., Lincoln Bldg., New York City.

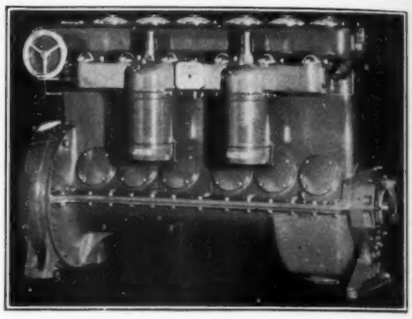
▼

An Improved Diesel Engine

The newest of Diesel engines has just been placed on the market by the Murphy Diesel Company, Ltd., of Milwaukee. It is a 5¾x6½, six cylinder unit, with an economical horsepower range from 100 H.P. to 150 H.P.

A new fuel injection system is considered an outstanding feature, as is the improved starting, extremely sensitive governing, temperature control of Lube oil by the cooling water, elimination of perceptible torsional vibration, and balanced drive.

"We have combined the fuel pump and nozzle," says Mr. Murphy, "in a single



Murphy Diesel Engine

injector unit which is placed in the center of the cylinder head and surrounded by four valves. This injector is actuated directly by two camshafts, one on each side of it, thus forming a balanced drive. Oil is delivered to cylinder head centered injectors, surrounded by four valves, under 10 lbs. pressure, in excess of maximum demands, surplus oil being returned to the fuel tank. Air-bound lines are completely eliminated. Actual injector pressure of the fuel into the combustion chamber ranges from 2,000 lbs., when idling, to 4,500 lbs. at maximum speed. High pressure fuel lines are eliminated as are fuel line pulsations, with resulting engine knock elimination."

A 4-in. diameter, seven-bearing crankshaft, statically and dynamically balanced and overhead cam-shaft drive from the fly-wheel end assures an exceptionally smooth, quiet drive.

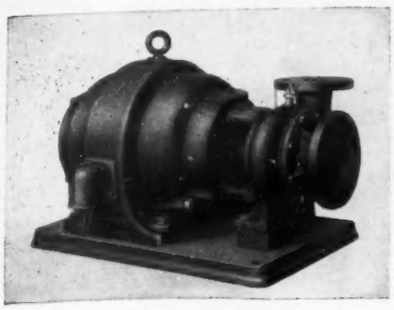
For more effective description of the new M. D.-Diesel, address Murphy-Diesel Co., Ltd., Milwaukee, Wis.

▼

Monobloc Pumps in Larger Sizes

The line of compact Worthington Monobloc pumping units of 1 to 2½ in. size which proved so popular and convenient, has been extended to include 3 and 4 in. units. Improvements announced by Worthington Pump and Machinery Corporation include impeller design, renewable wearing rings, balance rings to eliminate end thrust and to put the stuffing box under suction pressure only—all designed to increase efficiency and life of the Monobloc units. The unit is rigidly mounted on the motor frame, the impeller

being mounted directly on the motor shaft. Pump and motor being bolted to a rigid base, relief from pipe strain is assured splash proof, explosion proof, or stand-



Worthington Monobloc Pumping Unit

ard motors are available and mounting may be horizontal or vertical.

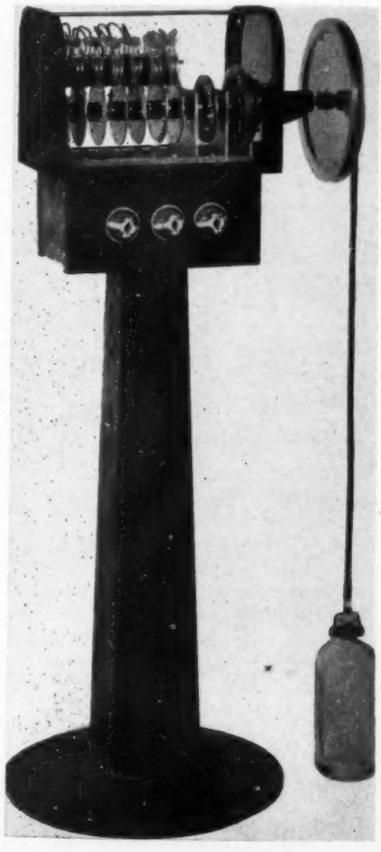
For more adequate description write for illustrated Bulletin W-321B 4 and W-321-B3 Worthington Monobloc Centrifugal Pumps. Address Worthington, Harrison, N. J.

▼

Automatic Selector for Sewage Pump Control

The Automatic Selector, a new instrument for the control of multiple-pump operations at sewage pumping stations, has been designed by Automatic Control Company, manufacturers of automatic controls for water works and sewerage systems.

Where there are a combination of two



The Automatic Selector

or more pumps in a station the Automatic Selector serves, as its name implies, to automatically throw into operation the pump or any combination of pumps which will most efficiently handle existing sewage flow to the suction well during any given period. It serves to balance kilowatt demand against flow of liquid to be handled.

The adjustment of the instrument can be readily altered to secure any desired operating sequence of the pumps available and, thereby, elminate repeated frequent starting and stopping of the units. The mechanism is actuated by a single heavy glass float suspended from a stainless steel tape wound on the pulley seen on the right. The cam wheels operate the enclosed mercury switches—the instrument except for the pulley being completely enclosed and is constructed of corrosion proof metals.

The operation of the instrument is readily understood when referring to descriptive bulletins being distributed by the company. Write Automatic Control Company, 2590 University Avenue, St. Paul, Minn., for literature describing "The Automatic Selector."

NOTE: Minneapolis-Honeywell Regulator Co. of Minneapolis are distributors of the Automatic Selector and also other Automatic Control equipment.

▼

WITH THE MANUFACTURERS

Brown Instrument and Minneapolis-Honeywell Regulator Open Southern Office

Tht Brown Instrument Co. of Philadelphia, Pa., manufacturers of instruments and controls, and the Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., manufacturers of Control Systems and regulators, have opened a joint office at 101 Marietta Street Building, Atlanta, Ga.

Mr. W. R. Moore, for a number of years District Manager of Brown Instrument Company, is in charge.

A Minneapolis-Honeywell stock will be carried, and complete sales and installation service maintained at this office for the complete lines of both companies.

▼

Lawrence Machine and Pump Co. Purchased by Victor J. Mill

The Lawrence Machine and Pump Company of Lawrence, Mass., has been recently bought by an engineer of long experience, in pump design, manufacture and sales, Victor J. Mill of Baldwinsville, N. Y.

The Lawrence Machine and Pump Company will continue to manufacture pumps at Lawrence under its well-established name. This company was founded in 1882 and is thought to have produced the first centrifugal pump in America, and, at one time, was considered the leader in its field.

Mr. Mill leaves the Morris Machine Works (Morris Pumps) of Baldwinsville, N. Y., after a connection there for 19 years, the last 8 of which he was a director of the company and had charge of engineering and sales. Mr. Mill holds the three patents covering improvements in centrifugal pump design. As an engineer of pump design he has had wide experience and he plans to continue the "Lawrence" line of water and sewage pumps with many new and improved design features added.

▼

Paul Nickerson to Sell "Mineralead"

Paul M. Nickerson has recently joined the Atlas Mineral Products Corp., of Mertztown, Pa., producers of "Mineralead" pipe jointing compound. He will have headquarters in Chicago and represent the company in three important states, Illinois, Michigan and Indiana. Mr. Nickerson was formerly Manager of the Albany office of the Paradon Company—manufacturers of chlorinators.

▼

Crane Establishes a Water Works Department Headed by W. A. Dallach

Crane Company of Chicago have recently established a Water Works Department at 836 South Michigan Avenue, to give special services to purchasers of valves, fittings and other Crane equipment sold in the water works and sewerage fields.

W. A. Dallach, who has been placed in charge as Manager of the new Water

W. A. Dallach

Works Department, has been connected with Crane Company for 23 years. He has served in the design, experimental and development departments before coming to the Sales Division as sales engineer. Such experience has been invaluable to him in advisory and sales work and his recent promotion is the result. Mr. Dallach will represent Crane Company in all water works and sewerage transactions.

▼

Catalogs and Trade Literature Received

"Crane Double Disc Gate Valves"—(A correction: In our February issue there was a review of the new Crane Company brochure—their "Double Disc Gate Valve for Water Works and Sewerage" and a listing of the features of the new No. 408½ line of valves. The number given is erroneous. These improved valves are specified as Crane No. 480½ Double Disc Gate Valves. To Crane Co., we apologize for the error.

E. C. & M. Automatic Pump Control—A new brochure of 16 pages de-

scribes and illustrates Electric Controller and Manufacturing Company's successful automatic pump and altitude control equipment for closely regulating tank levels, pressures, pumping rates and number of units in service—all within closely set ranges without the installation of a wiring system from tank to pumping station. Set forth are a variety of municipal and industrial problems solved by E. C. & M. Also there are many illustrations of varied successful installations including those involving the automatic use of "off-peak" cheap power; automatic control of out of touch and widely scattered stations for both water and sewage pumping. Featured in the latter is the E. C. & M. Multi-Unit Pump Control System for more economical and efficient sewage pumping to treatment works. Ask for Bulletin 25, address Electric Controller and Manufacturing Company, 2700 East 79th Street, Cleveland, Ohio.

Nichols Herreshoff Incinerator—A pamphlet describing a type of multiple hearth incinerator which has had years of service in ore roasting and sulphuric acid production. An N. H. Incinerator is now in successful operation on chemically precipitated sewage sludge, at the Dearborn Sewage Treatment Plant at operating costs and fuel consumption well below guarantee. Clinker proof compact and heat recovering this incinerator is illustrated by cross-sectional drawings. Request Bulletin 202, Nichols Engineering & Research Corp., 40 Wall Street, New York City.

Modern pH and Chlorine Control—A booklet of 54 pages bearing this title illustrates and describes improved pH and Chlorine Control Equipment Materials—featuring the slide type comparators developed by W. A. Taylor & Company of Baltimore, Md. The first part of the booklet is given over to the "Meaning of pH Control," including the explanation of pH and theoretical discussion, and applications of pH Control in the industrial field and in water and sewage treatment. Then follows an exposition of "Chlorine Control Methods and Equipment." It is noted that an important addition to the line of Taylor Chlorine Comparator sets is one capable of measuring residual chlorine values from 5 to 250 p.p.m. without dilution. The new method with a five-year guarantee on color standards was developed for the paper, dairy, bottling, and laundry fields, and others in which concentrated chlorine solutions are employed. Free distribution by W. A. Taylor & Co., 872 Linden Ave., Baltimore, Md.

Liquid Chlorine—In a new 40 page brochure Solvay Sales Corp. has compiled valuable up to date information on the properties, the handling and the uses of liquid chlorine. Technical data on chlorine (gas and liquid) is followed by a description of cars, containers, cylinders and valves used in chlorine transportation; handling equipment; design and specifications for chlorine feed lines; safety measures and leak control; methods of preparing hypochlorite solutions with lime or soda; quick analytical procedures; chlorine reaction equivalents and conversion factors. On the inside back cover first aid measures are set forth. "Liquid Chlorine" will, without question, serve as a valuable reference booklet and source of information for engineers and operators. Free distribution, by Solvay Sales Corp., 40 Rector St., New York City.

Globe Geophone and Dip Needle—A catalog supplement describes the Globe Geophone, stated to be the most sensitive and dependable instrument developed for leak location on pipe lines. There appears a long list of satisfied users. Another supplement describes the inexpensive and compact Globe Dipping Needle (based on 25 years' experience) for locating pipe lines, valves, meter boxes, buried manhole covers and the like. On both instruments free trials are offered. Address Globe Phone Manufacturing Corp., Reading, Mass.

Improved Phipps-Bird Solution Feeders—A 12 page booklet describes the improved corrosion resistant chemical solution feeders produced by Phipps-Bird, Inc., produced to insure accurate and dependable feed at a low initial and operating cost. Especially useful in feeding alum, ferric chloride and hypochlorite solutions the improved feeder does not deteriorate from use or from standing idle, has a non-clog type of glass syphon feed orifice and is subject to semi-automatic (start and stop) control with intermittent pump operations. Address Phipps & Bird, Inc., 915 E. Cary St., Richmond, Va.

Improvements in Centrifugal Pipe Casting—In the "U. S. Piper" there appears an illustrated article which describes the improved method of manufacture of centrifugal cast-iron pipes, which has so markedly improved the quality of pipes cast by the DeLavaud process. The authors, Stuart and Linderman, have done an excellent job of presenting this picturized story, and anyone interested in cast iron pipe would gain by writing U. S. Cast Iron Pipe and Foundry Co. at Burlington, N. J., requesting a copy of U. S. Piper for December, 1934.

Rex Sludge Pumps—Is a bulletin describing and illustrating Chain Belt's Rex (Plunger Type) Sludge Pumps in actual service and listing 33 satisfied users. Among the 10 outstanding features named are: Use of inside packing to insure strong positive plunger suction and self priming: circulating oil lubrication; multi-speed motor and adjustable stroke of 3 to 5 in.; Herringbone-Maag gear reducer, with Timken bearings; walking beam for straight thrust on plungers to prolong life of plungers and packing; non-clog flap valves and accessible sampling device easily used. Ask for Bul. 249, "Rex Plunger Sludge Pumps." Address Chain Belt Co., Sanitation Division, Milwaukee, Wis.

The Western Fire Hydrant—A bulletin describing the special features of the Western Fire Hydrant in sizes 4 to 6 in., manufactured by Western Gas Construction Co. and built to comply with A. W. W. A. specifications. Features: Ball thrust bearings insuring positive, easy opening and closing of valve; stream lined openings and large passageways minimize pressure loss, insure maximum delivery; nine openings around non-corrosive bronze seat ring insures rapid, dependable drainage of hydrant barrel. Ask for Bulletin No. 307, Western Gas Construction Co., Fort Wayne, Ind.

Adjustable Valve Boxes—A new bulletin received from Buffalo Pipe and Foundry Co. describes and illustrates a line of ingenious valve and curb cock boxes which are adjustable as to length (height), in screw or sliding section types, with square or round heads, open or flanged bases—in all standard diameters. A stopcock holder which insures dirt free and upright centered position of stopcocks, when used with the curb box, is also illustrated. Ask for Bulletin No. 35. Address Buffalo Pipe and Foundry Corp., Box 23, Sta. B., Buffalo, N. Y.

Worthington Gas Engines—A new bulletin describing and illustrating improved Worthington Gas Engines suitable for burning digester gas for power production at sewage treatment plants. Available in 2 to 8 cylinder units direct connected to electric generators with power range of 60 to 1,000 H.P., these engines are built by a firm which has produced gas engines for 35 years. Continuous operation at full load is not only permissive but recommended. Anyone interested in power development from digester gas should study the 27 salient features outlined in the new bulletin, "Worthington Gas Engines." Address Worthington Pump and Machinery Corp., Harrison, N. J. strength Asbestos-Cement "Transite" pipe and give its qualities and applica-

Transite Pipe—In a booklet of 18 pages, Johns-Manville Company tell the story of the manufacture of high tions in the water supply field. Installations are pictured and specifications given. For a copy of "Transite Pressure Pipe" address Johns-Manville, 22 E. 40th St., New York City.

Taste and Odor Control—A discussion by H. B. Crane of preventive and corrective taste and odor control procedures which have proved most practical in modern methods of water treatment is presented by International Filter Company in a 4-page leaflet. Choices of methods are discussed—among which is stressed the use of pre-chlorination for oxidation, followed by filtration through granular "Hydrocarco" (activated carbon) units for small supplies; and, the application of powdered "Hydrodarco" in conjunction with the filtration of large supplies. Ask for Technical Bul. 6005. Address International Filter Company, 59 E. Van Buren St., Chicago, Ill.

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Only one tool is needed to install a Dresser joint—a Ratchet Wrench to pull up the bolts. This one tool completely eliminates the need for noisy, expensive, complicated jointing equipment that involves heat or power. • With Dresser Ratchet Wrenches and Dresser Couplings, unskilled labor can make permanently, ABSOLUTELY tight joints in minimum time. Manual operation of a Dresser Wrench requires very little effort and is exceptionally fast. The resulting tightness of the joints never fails to impress the engineer who has experienced difficulties with other types of construction.

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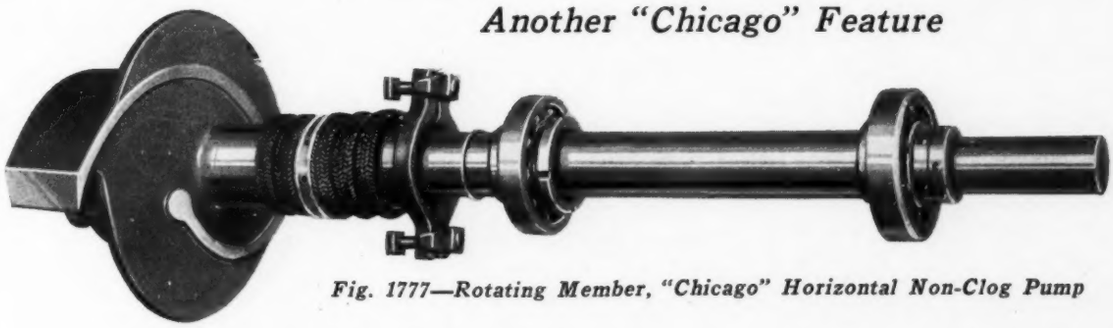

Fig. 1777—Rotating Member, "Chicago" Horizontal Non-Clog Pump

This photograph shows how the blades extend through the back of the "Chicago" Non-Clog impeller. They cause the same pumping action behind the impeller as in front of it. This prevents rags and other material from getting between the back of the impeller and the pump casing where they might become packed tight enough to bind the pump. Note that there are five rings of packing on the shaft.

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pH *And Its* Practical Application

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William R. Kenny
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Table of Contents

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I—Introduction and Preliminary Discussion
II—Hydrogen and Hydroxyl Ions
III—Buffer Action
IV—Determination of pH
V—Sources of Error

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XIV—Food Industries
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XIX—Soils

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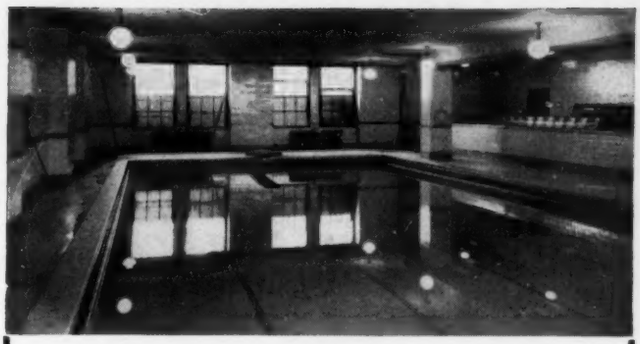

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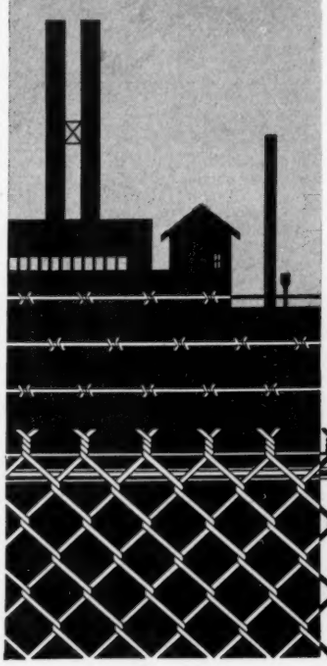

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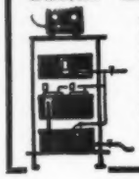

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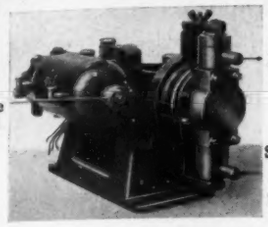

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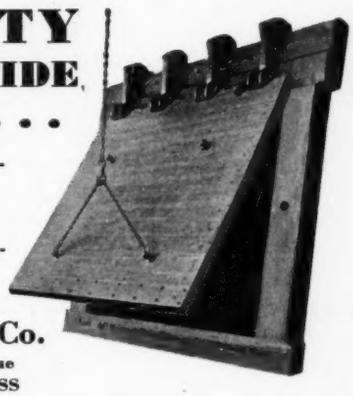

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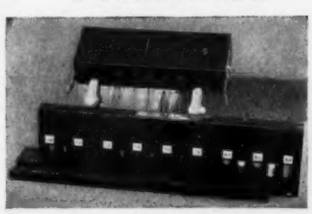

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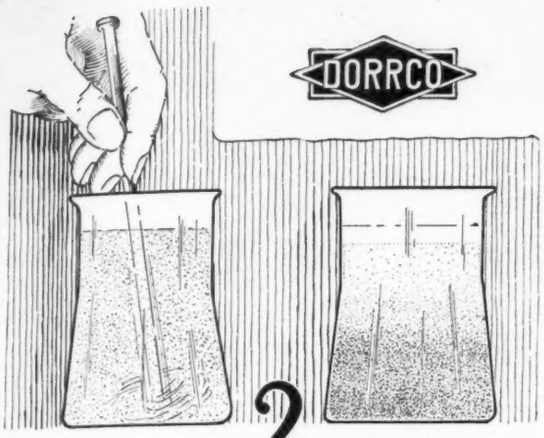

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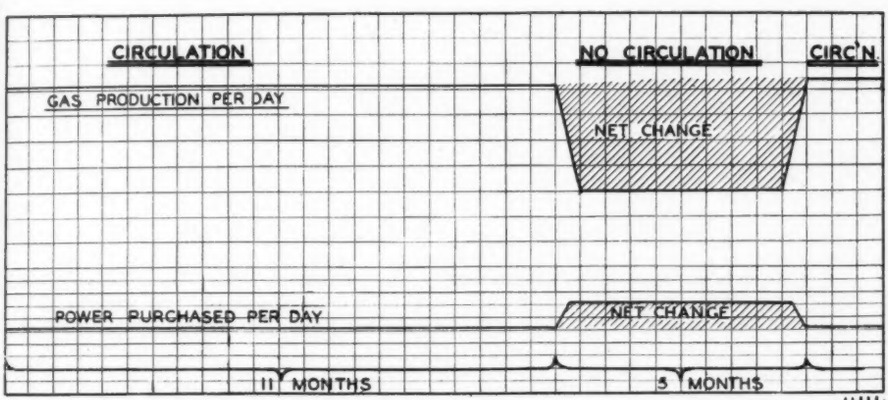

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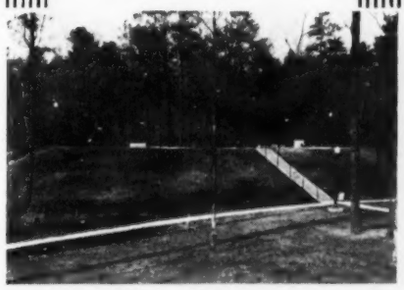

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